

Compton College New Student Services Building

tBP Project No. 20987.00

DSA #3 - 119686

File #

Bid No:

Compton College
Compton, California

PROJECT MANUAL

Volume 1 of 2
Divisions 00 - 14
September 2019

■ **Architect:**

tBP/Architecture

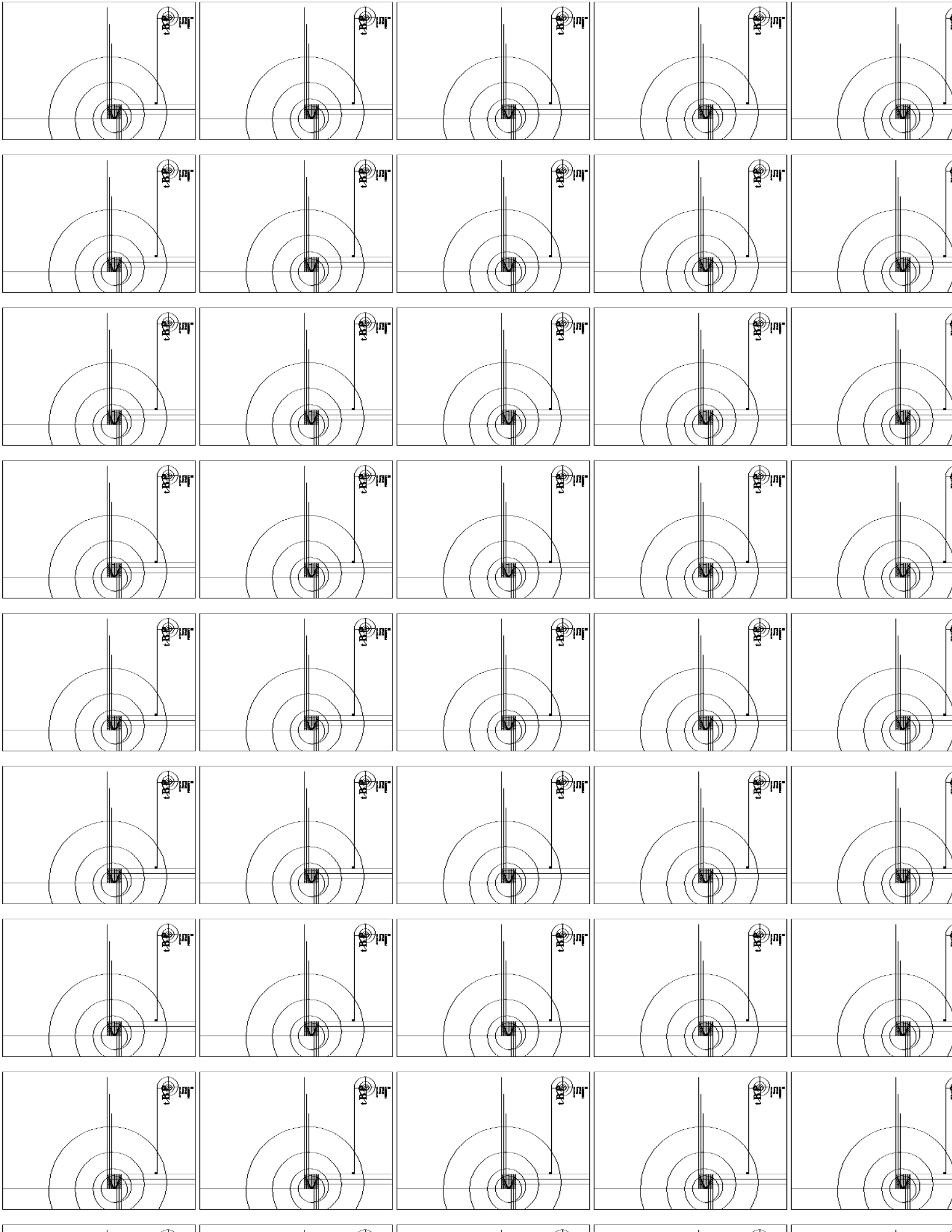
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tBP

Architecture
Planning
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Management





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PROJECT TITLE PAGE
PROJECT MANUAL**

FOR

NEW STUDENT SERVICES BUILDING

PROJECT NUMBER: 20987.00

DISTRICT

**COMPTON COMMUNITY COLLEGE DISTRICT
1111 E. ARTESIA BOULEVARD, COMPTON CA 90221
310.900.1600
WWW.COMPTON.EDU**

PROJECT LOCATION

**COMPTON COLLEGE
1111 E. ARTESIA BOULEVARD
COMPTON , CALIFORNIA 90221**

PREPARED BY:

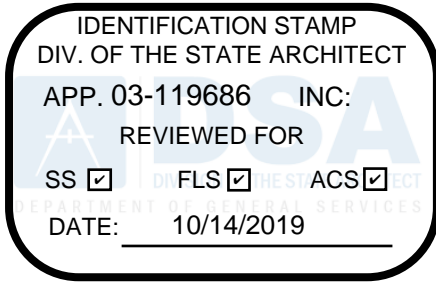
ARCHITECT

TBP/ARCHITECTURE, INC.

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END OF PROJECT TITLE PAGE



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SEALS PAGE**

ARCHITECT

TBP/ARCHITECTURE, INC.

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Architect of Record (AOR)



STRUCTURAL ENGINEER

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Structural Engineer of Record (SEOR)



MECHANICAL ENGINEER

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11020 Sun Center Drive, Suite 100, Rancho Cordova California 95670

Plumbing Engineer of Record (PEOR)



DATE SIGNED: 02/26/19

PLUMBING ENGINEER

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Plumbing Engineer of Record (PEOR)



DATE SIGNED: 02/26/19

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FPL & ASSOCIATES

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License: 
Alan Wing-Chi Lee
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Civil Engineer of Record (CEOR)



LANDSCAPE ARCHITECT

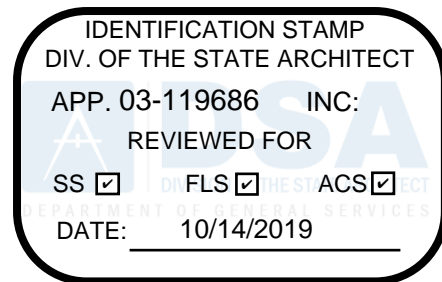
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Landscape Architect of Record (LAOR)



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END OF SECTION

SECTION 00 31 00
AVAILABLE PROJECT INFORMATION

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 the Contract Documents, as follows:
- B. Geotechnical Report: Entitled Geocon West, Inc. (Project No. A9562-88-01), dated November 13, 2018.
 - 1. Original copy is available for inspection at District's offices during normal business hours.
 - 2. 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.
 - 3. 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.
 - 4. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in the Contract Documents.
 - 5. 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

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ALLOWANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Allowances which the Contractor shall provide for designated construction activities in the Work and in this bid.
- B. The provisions in this Section only apply if the Owner includes Allowances in the Contract.

1.2 RELATED DOCUMENTS

- A. The Conditions of the Contract and other section of Division 01 apply to this section as fully as if repeated herein, including Section 01 01 00 – Scope of Work.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Definitions and Explanations: Certain requirements of the construction related to each allowance are indicated and specified. The Allowance has been established by the Owner and represents selection by the Owner of selected Sub-Contractors for designated portions of the work specified and shown.
- B. Types of allowance scheduled herein for the Work include lump sum cash allowances. Include all allowances in Contract sum, and identify all allowances in Schedule of Values as separate line items.
- C. Selection and Purchase: At earliest feasible date after award of contract, advise the Architect/Engineer of scheduled date when final selection and purchase of each product or system described by each allowance must be accomplished in order to avoid delays in performance of the Work.
 - 1. Establish date by which Prime Contractor must enter into contract and coordinate with sub-contractor responsible for work defined by allowance.
 - 2. Establish date by which final list of products must be established for purchase of products and systems as specifically selected by the District.

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1.4 DEFINITIONS AND DESCRIPTION OF REQUIREMENTS

A. Cash Allowance Criteria

1. The Allowance is used only as directed by the Owner.
2. The Allowance is used exclusively for the Owner's purposes and for scope(s) of work as directed by Owner.
3. The sub-contractor will prepare detailed breakdown of all costs associated with the work defined for the Allowance. These amounts will be charged against the Allowance by Change Order, based on final detailed payment receipts and back-up as required by Architect/Engineer, and will include all costs of work performed under the defined work scope.
 - a. If required by Owner, Contractor shall obtain quotes for equipment from three separate vendors and present to District for consideration and selection.
4. Contractor shall include in the base bid contract amount all cost of coordination, supervision, bond costs, overhead and profit, supervision, installation and all indirect project costs associated with performing the work of each Allowance. Contractor shall be permitted to charge only its direct costs to perform the work, as indicated through documentation approved by the District.
 - a. At project closeout, any unused Cash Allowance amounts shall be credited to the Owner by Change Order. Contractor shall not deduct costs such as bond costs, overhead and profit or other indirect costs when returning any unused Cash Allowance amounts.
 - b. Changes that exceed the scope of work or amount of each Allowance covered by each allowance will be processed as a Change Order per Contract Documents.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION

3.1 SCHEDULE OF CASH ALLOWANCES

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1. This Contractor will provide a \$500,000.00 Allowance which is to be included in the base bid. This allowance is to be used at the District's discretion.

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ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for Alternates.
- B. Definition: An Alternate or Alternate Bid is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from Base Bid amount if the School District decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.
- C. Coordination: Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each accepted Alternate is complete and fully integrated into the project.
- D. Notification: Immediately following the award of the Contract, prepare and distribute to each party involved, notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.
- E. A "Schedule of Alternates" is included as an attachment at the end of this section.
 - 1. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.
- B. Bid Form

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PART 2 – PRODUCTS - (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. There are no alternates on this bid.

END OF SECTION

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CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for making modifications to the contract including:
 - 1. Change Orders/Allowance Usage
 - 2. Construction Change Documents (see General Conditions)
 - 3. Contract Credits
 - 4. Contract Additions
 - 5. Construction Change Directives
 - 6. Emergency Change Directives (see General Conditions)
 - 7. Instructions

- B. Modifications:
 - 1. Provide full written data required to evaluate contract modifications, including breakdown of labor, material, equipment and description of work with unit costs for each category.
 - 2. Maintain detailed records of work done on a time-and-material basis.
 - 3. Provide full documentation for all proposed Change Orders to the Architect for his review.

- C. Designate in writing the member of Contractor's organization:
 - 1. Who is authorized to accept changes in the Work.
 - 2. Who is responsible for informing others in the Contractor's employ of the authorization of changes in the Work.

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1.2 RELATED SECTIONS

- A. Addenda: All issued Addendums
- B. Agreement: The amounts of unit prices if any as established in the Contract.
- C. General Conditions Article 9, Changes in the Work.
- D. Section 01 33 00 - Submittals
- E. Section 01 63 00 - Product Substitution Procedures

1.3 REFERENCES

- A. Change Order Requirements per Title 24 Part 1 CCR.
 - 1. Changes in the plans and specifications are to be made by addenda or Change Orders or construction change documents approved by the Division of the State Architect, Title 24 Part 1 Section 4-338.
 - 2. Change Orders: Changes or alterations of the approved plans or specifications after a contract for the work has been awarded are to be made by means of Change Orders. State the reason for the change and provide supplementary drawings where necessary. Change Orders must be manually signed by the Architect or Engineer in general responsible charge of observation of the work or by the Architect or Engineer delegated responsibility for observation of the portion of the work affected by the Change Order.
 - 3. Change Orders are required to bear the approval of the School Board or their authorized representative upon delegated authority.
 - 4. One original signed copy by all parties of each Change Order is required for the files of the Division of the State Architect.

1.4 PRELIMINARY PROCEDURES

- A. The Architect or School District may initiate changes by submitting a Request For Quotation. The request will include:

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1. Detailed description of the Change, Products, and location of the change in the Project. Changes may include additions and deletions from the Contract.
 2. Supplementary or revised Drawings and Specifications.
 3. The projected time span for making the change and a specific statement as to whether overtime work is, or is not, authorized.
 4. A specific period of time during which the requested price will be considered valid.
 5. Such request is for information only, and is not an instruction to execute the changes, nor to stop Work in progress.
- B. Contractor may initiate changes by submitting a written Allowance Usage Request or Proposed Change Order Request to the Architect or School District containing:
1. Description of the proposed change.
 2. Statement of the reason for making the changes.
 3. Statement of the effect on the Contract Sum/ Contract Price and the Contract Time.
 4. Statement of the effect on the Work of separate contractors with breakdown of costs for labor, materials and equipment.
 5. Documentation supporting any change in Contract Sum/ Contract Price or Contract Time, as appropriate.

1.5 CONSTRUCTION CHANGE DIRECTIVES

- A. In lieu of Proposal Request, the School District through the Construction Manager may issue, a Construction Change Directive (also referred to as an Immediate Change Directive in the General Conditions) for Contractor to proceed with a change which shall state a basis for adjustment, if any, in the Contract Sum/ Contract Price or Contract Time, or both.
- B. Authorization will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change, and will designate the method of

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determining any change in the Contract Sum/ Contract Price and any change in Contract Time.

- C. The School District and Architect will sign and date the Construction Change Directive as authorization for the Contractor to proceed with the changes.
- D. Contractor may sign and date the Construction Change Directive to indicate agreement with the terms therein.

1.6 DOCUMENTATION OF PROPOSALS AND CLAIMS

- A. Support each quotation for a lump-sum proposal, and for each unit price which has not previously been established, with sufficient substantiating data to allow the Architect/Engineer and School District to evaluate the quotation.
- B. On request provide additional data to support time and cost computations:
 - 1. Labor required in hours with unit costs.
 - 2. Equipment required.
 - 3. Products required in units.
 - a. Recommended source of purchase and unit cost.
 - b. Quantities required.
 - 4. Taxes, insurance and bonds.
 - 5. Credit for Work deleted from Contract, similarly documented.
 - 6. Overhead and profit.
 - 7. Justification for any change in Contract Time.
- C. Support each claim for additional costs, and for work done on a time and material basis, with documentation as required for a lump-sum proposal, plus additional information:
 - 1. Name of the School District's authorized agent who ordered the work, and date of the order.
 - 2. Dates and times work was performed, and by whom.

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3. Time record, summary of hours worked, and hourly rates paid.
 4. Receipts and invoices for:
 - a. Equipment used, listing dates and times of use.
 - b. Products used, listing of quantities.
 - c. Subcontracts.
- D. Document requests for Substitution of Products as specified in Section 01 63 00.

1.7 CONSTRUCTION CREDITS

- A. Work deleted and no work has been completed by the Contractor: Work deleted from the contract is to be credited back to the District and subtracted from the contract amount. Credits are to be included in Change Orders.
1. Contractor shall credit back to the District total value for the work deleted from the contract. Cost of credits shall be determined by the amount stated in the Contractor's Schedule of Values.
 2. Where the value of credits cannot be determined from the Contractor's Schedule of values, total value of the credit is to be determined by the cost of materials, labor, overhead and profit, insurance, bonds, etc. All General Contractor, Subcontractor and Material Supplier levels of the Contract are to be included in the total value of credits back.
 3. No amount at any level of the contract shall be withheld from credits for overhead and profit, insurance, bonds, time delays, construction schedule changes and administrative expenses.
- B. Work deleted and a portion of the work has been completed by the Contractor: Work deleted from the contract is to be credited back to the District and subtracted from the contract amount. Credits are to be included in Change Orders.
1. Contractor shall credit back to the District the total value of the work deleted from the contract less any work already

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completed on the credit item. Cost of credits shall be determined by the amount stated in the Contractor's Schedule of Values less any work already completed. Completed work may include cost of shop drawings, submittals, site preparation, partially completed work on the credit item or other expenses related to the item.

2. Where the value of credits cannot be determined from the Contractor's Schedule of values, total value of the credit is to be determined by the cost of materials, labor, overhead and profit, insurance, bonds, etc. All General Contractor, Subcontractor and Material Supplier levels of the Contract are to be included in the total value of credits back.
3. An amount equal to the percentage of work already completed on the deleted item may be withheld from credits back for overhead and profit, insurance, bonds, construction schedule adjustments and administrative expenses, as indicated in the General Conditions (Section 00700).

1.8 PREPARATION OF CHANGE ORDERS

- A. The Architect or Construction Manager will prepare each Change Order.
- B. Change Order will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
- C. Change Order will provide an accounting of the adjustment in the Contract Sum/ Contract Price and in the Contract Time.

1.9 LUMP-SUM/FIXED PRICE CHANGE ORDER

- A. Content of Change Orders will be based on either:
 1. The School District's Proposal Request and Contractor's responsive Proposal as mutually agreed with the School District.
 2. Contractor's Proposal for a change, as recommended by the School District or their authorized agent.
- B. The School District, Division of the State Architect and Architect or Engineer in responsible charge will sign and date the Change

COMPTON COMMUNITY COLLEGE DISTRICT

Order as an authorization for the Contractor to proceed with the changes.

- C. The Contractor will sign and date the Change Order to indicate agreement with the terms therein.

1.10 UNIT PRICE CHANGE ORDER

- A. Content of Change Orders will be based on either:
 - 1. The School District's definition of the scope of the required changes.
 - 2. Contractor's Proposal for a change, as recommended by the School District or Authorized Agent.
 - 3. Survey of completed work.
- B. The amounts of the unit prices to be:
 - 1. Those stated in the Agreement.
 - 2. Those mutually agreed upon between School District and Contractor.
- C. When quantities of each of the items affected by the Change Order can be determined prior to start of the work:
 - 1. The School District and Architect or Engineer in responsible charge will sign and date the Change Order as authorization for Contractor to proceed with the changes.
 - 2. Contractor is to sign and date the Change Order to indicate agreement with the terms therein.
- D. When quantities of the items cannot be determined prior to start of the work:
 - 1. The School District through the Architect will issue a Construction Change Directive directing the Contractor to proceed with the change on the basis of unit prices, and will cite the applicable unit prices.
 - 2. At completion of the change, the School District or its authorized agent will determine the cost of such work based on the unit prices and quantities used.

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3. The Contractor shall submit documentation to establish the number of units of each item and any claims for a change in Contract Time.
4. The School District, Division of the State Architect and Architect or Engineer in responsible charge will sign and date the Change Order as authorization for the Contractor to proceed with the Changes.
5. The Contractor will sign and date the Change Order to indicate agreement with the terms therein.

1.11 TIME AND MATERIALS CHANGE ORDER/CONSTRUCTION CHANGE DIRECTIVE:

- A. The School District through the Architect will issue a Construction Change Directive directing Contractor to proceed with the changes
- B. At completion of the change, Contractor shall submit itemized accounting and supporting data as provided in the Article 1.6, "Documentation of Proposals and Claims," of this Section.
- C. The School District or its authorized representative will determine the allowable cost of such work, as provided in General Conditions and Supplementary Conditions.
- D. The School District, Division of the State Architect and Architect or Engineer in general responsible charge will sign and date the Change Order to authorize the change in Contract Sum/ Contract Price and in Contract Time.
- E. The Contractor will sign and date the Change Order to indicate agreement with the terms therewith.

1.12 INSTRUCTIONS

- A. Architect's Supplemental Instructions:
 1. Minor changes in the work shall be carried out in accordance with supplemental instructions issued in accordance with the Contract Documents without change in Contract Sum/ Contract Price or Contract Time.
 2. The Architect will issue, sign, and date Supplemental Instructions.

COMPTON COMMUNITY COLLEGE DISTRICT

3. The Contractor will sign and date Supplemental Instructions to indicate acceptance of minor changes consistent with the Contract Documents and return signed copy to Architect.

1.13 CORRELATION WITH CONTRACTOR'S SUBMITTALS

- A. Periodically revise Schedule of Values and Request for Payment forms to record each change as a separate item of Work and to record the adjusted contract amounts.
- B. Periodically revise the Construction Schedule to reflect each change in Contract Time.
- C. Revise sub-schedules to show changes for other items of work affected by the changes.
- D. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

1.14 FORMS

- A. Submit Proposal Request typed on AIA Document G709. A Copy of this form may be obtained from the local American Institute of Architects, Chapter Office
- B. Submit Change Orders typed on the Change Order Form included in this Project Manual. Form is included in General Conditions and at the end of this Section.
- C. Submit Potential Change Order on the Potential Change Order Form included in this Project Manual. Form is included in General Conditions and at the end of this Section
- D. Submit Supplemental Instructions typed on the form included in this Project Manual on 01 30 50-24, Requests For Information (RFI's).
- E. Immediate Change Directive Form is included in the Supplementary General Conditions.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

COMPTON COMMUNITY COLLEGE DISTRICT

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. Submit applications for payment to Construction Manager in accordance with the schedule established by the conditions of the Contract and Agreement between Owner and Contractor.
- C. The Contractor's Construction Schedule and Submittal Schedule are included in Section "Submittals".
- D. The Contractor agrees to provide an updated certified "As-Built" with every pay application both "Hard Copy" and electronic copy that is approved by the Architect/ Engineer, Inspector of Record, and the Construction Manager.

1.2 SCHEDULE OF VALUES

- A. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.
 - 1. Submit the Schedule of Values to the Construction Manager at the earliest feasible date, but in no case later than 10 days before the date scheduled for submittal of the initial Application for Payment.
- B. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of the Architect/ Engineer.
 - c. Project number.
 - d. Contractor's name and address.

COMPTON COMMUNITY COLLEGE DISTRICT

- e. Date of submittal.
2. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:
 - a. Generic name.
 - b. Related Specification Section.
 - c. Name of subcontractor.
 - d. Dollar value.
 - e. Percentage of Contract Sum/ Contract Price to the nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum/ Contract Price in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into specific line items.
4. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum/ Contract Price.
5. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
6. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum/ Contract Price.

1.3 APPLICATIONS FOR PAYMENT:

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect/ Engineer and paid for by the School District.
- B. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work

COMPTON COMMUNITY COLLEGE DISTRICT

covered by each Application or Payment is the period indicated in the Agreement.

- C. Payment Application Forms: Use AIA Document G702 and Continuation Sheets G 703 as the form for Application for Payment.
- D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the School District. Incomplete applications will be returned without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.
 - 3. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Engineer and Construction Manager.
 - 4. When the Architect/ Engineer finds the application completed and correct will transmit a certificate for payment to Owner with a copy to the Contractor.
- E. Lien Releases: With each Application for Payment submit Lien Releases from subcontractors or sub- subcontractors and suppliers for the construction period covered by the previous application.
 - 1. Submit partial Lien Releases on each item for the amount requested, prior to deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit final or full Lien Releases.
 - a. Submit final Application for Payment with or preceded by final Releases from every entity involved with performance of Work covered by the application that could lawfully be entitled to a lien.
 - 3. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to the School District.

COMPTON COMMUNITY COLLEGE DISTRICT

- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include, without limitation, the following (see also General Conditions):
1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Copies of authorizations and licenses from governing authorities for performance of the Work.
 5. Certificates of insurance and insurance policies.
 6. Performance and payment bonds (if required).
- G. Application for Payment at Substantial Completion: Upon Substantial Completion, submit an Application for Payment.
1. Administrative actions and submittals that shall proceed or coincide with this application include, without limitation, the following (see also General Conditions):
 - a. Project inspector's status of completion report.
 - b. Warranties (guarantees) and maintenance agreements.
 - c. Test/adjust/balance records.
 - d. Maintenance instructions.
 - e. Meter readings.
 - f. Start-up performance reports.
 - g. Change-over information related to Owner's occupancy, use, operation and maintenance.
 - h. Final cleaning.
 - i. List of incomplete Work, recognized as exceptions to the Certificate of Substantial Completion.

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- H. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final payment Application for Payment include, without limitation, the following (see also General Conditions):
1. Completion of Project closeout requirements.
 2. Completion of items specified for completion after Substantial Completion.
 3. Assurance that unsettled claims will be settled.
 4. Assurance that Work not complete and accepted will be completed without undue delay.
 5. Transmittal of required Project construction records to Owner.
 6. Removal of temporary facilities and services.
 7. Removal of surplus materials, rubbish and similar elements.
 8. Submit the final complete "As-builts" both hard copy and electronic copies with proper electronic titles for each page.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

COMPTON COMMUNITY COLLEGE DISTRICT



COMPTON COMMUNITY COLLEGE DISTRICT
1111 E. Artesia Blvd
Compton, California 92553
(310) 900-1600

RFQ CCC-XXX Student Services Building

POST BID INTERVIEW

1.1 SUMMARY

This Section requires each apparent low bidder to attend and participate in a POST BID INTERVIEW with the CONSTRUCTION MANAGER, prior to award of any contract by the DISTRICT. The POST BID INTERVIEW will be scheduled by the CONSTRUCTION MANAGER within three (3) calendar days after the date of bid. The Conditions of the Contract and all other Sections of the Contract apply to this Section as fully as if repeated herein.

1.2 REQUIRED ATTENDANCE

- A. A duly authorized representative of the apparent low bidder is required to attend the POST BID INTERVIEW, in person.
- B. The apparent low bidder's authorized representative must have signatory authority on behalf of the apparent low bidder.
- C. Failure to attend the POST BID INTERVIEW will be considered just cause for the District to reject the Bid.

Initials: _____
Contractor Construction Manager

COMPTON COMMUNITY COLLEGE DISTRICT

1.3 POST BID INTERVIEW PROCEDURE

- A. The CONSTRUCTION MANAGER will review the Bidder's Proposal with the attendees.

- B. The CONSTRUCTION MANAGER will review the Contract Documents with the attendees, including but not limited to:
 - 1. Insurance
 - 2. Bonding
 - 3. Addenda
 - 4. Pre-Bid Clarifications
 - 5. Scope of Work (Section 01 01 00)
 - 6. Bid Alternates and Voluntary Alternates
 - 7. Value Engineering
 - 8. The Contract Plans
 - 9. The Contract Specifications
 - 10. The Master Schedule
 - 11. Critical Materials
 - 12. General Contract Schedule Requirements
 - 13. Prevailing Wage Requirements
 - 14. Critical Dates Requirement for Other Bid Packages
 - 15. Liquidated Damages
 - 16. Required Documentation for Contract Administration
 - 17. Contract Coordination Requirements

1.4 POST BID INTERVIEW DOCUMENTATION

The CONSTRUCTION MANAGER will document the POST BID INTERVIEW on the form attached to this Section. Both the Apparent Low Bidder and the CONSTRUCTION MANAGER are required to sign the POST BID INTERVIEW Documentation. Signatures will be witnessed at the time of signing. POST BID INTERVIEWS will be conducted at the CONSTRUCTION MANAGER jobsite trailer.

Initials: _____
Contractor Construction Manager

COMPTON COMMUNITY COLLEGE DISTRICT

POST BID INTERVIEW FORM

CONSTRUCTION MANAGER FIRM

PCM3, Inc.
1111 E. Artesia Blvd.
Compton, CA 90221

BIDDER: _____

DATE: _____ TIME: _____ PHONE # _____

I. INTRODUCTIONS: (SIGN IN BELOW)

A. Present

_____	_____
CONTRACTOR	CONTRACTOR
_____	_____
_____	_____
_____	_____
CONSTRUCTION MANAGER	CONSTRUCTION MANAGER

II. PROPOSED CONTRACT: _____

III. PURPOSE OF INTERVIEW IS TO ASSURE:

- | | | |
|--|-----|----|
| A. Contractor acknowledgment of a complete and accurate bid. | Yes | No |
| B. Contractor submission of a fair and equitable bid. | Yes | No |
| C. Fair comparisons of bid. | Yes | No |

Initials: _____
Contractor Construction Manager

COMPTON COMMUNITY COLLEGE DISTRICT

IV. CONTRACTUAL REQUIREMENTS:

- A. Do you understand you are a prime contractor? Yes No
- B. Can you meet all specified insurance requirements? Yes No
- C. You are required to obtain a Performance, and a Labor and Material Bond for 100% of the Contract price Yes No
1. Is this acceptable? Yes No
2. Will you provide bonds as stipulated? Yes No
3. Cost for bond: _____% Yes No
4. Is the cost of the bond in your base bid? Yes No
5. Is your insurance company California licensed? Yes No
- D. Acknowledged Receipt of Addenda _____1 _____2 _____3 _____4 _____5
- E. Acknowledged Receipt of Pre-Bid Clarification Questions Yes No
- F. Are any costs for addenda items included in your proposal (if applicable)? Yes No

V. SCOPE OF WORK:

- A. You have a complete understanding of your Scope of Work under the proposed Agreement Yes No
- B. You have re-reviewed the documents and understand the Scope of the Work. Are there any items that need to be identified or require clarification? Yes No
- If yes, please identify item.
1. _____
2. _____
3. _____
4. _____
5. _____
- Is (are) the cost(s), as applicable, included in your proposal items? Yes No
- C. Review bid alternates (if applicable) NONE Yes No
- D. Are you offering any unsolicited alternates? NONE Yes No

Initials: _____
Contractor Construction Manager

COMPTON COMMUNITY COLLEGE DISTRICT

1. _____
2. _____
3. _____

E. Are the plans and specifications clear and understandable to your satisfaction? Yes No

VI. VALUE ENGINEERING: (describe for District Consideration)

1. _____
Add / Deduct _____
 2. _____
Add / Deduct _____
 3. _____
Add / Deduct _____
 4. _____
Add / Deduct _____
- AFFECTED TOTAL \$** _____

VII. SCHEDULE:

- A. Do you acknowledge and agree to the stipulated completion dates and milestones in the Contract? Yes No
1. Will you provide a detailed construction schedule to CONSTRUCTION MANAGER within the required three (3) days, per the Contract? (Section 00700) Yes No
 2. Can you expedite the schedule without impact to others? Yes No
 3. It is understood the Project schedule is critical. Can you accelerate any and all schedule activities if the requirement occurs? Yes No
 If not, what must change and why? _____

Initials: _____
 Contractor Construction Manager

COMPTON COMMUNITY COLLEGE DISTRICT

- B. Identify critical materials, deliveries and dependencies, including Owner Furnished items that could affect the completion of your work. Yes No

1. _____
2. _____
3. _____

- C. You have reviewed Section 01 43 80, CONSTRUCTION SCHEDULE and you understand your work must be completed in accordance with the **Master Schedule**. You further understand the District **MAY** assess liquidated damages if you fail to meet the Master Schedule requirements. You further understand delays by you may cause other contractors to be delayed, and that you **WILL** accelerate your work upon written direction by the CONSTRUCTION MANAGER.

CRITICAL DATES

PROJECT COMPLETION

Milestone Dates

Notice of Award and State Chancellor Office Approval	01/16/19
All Submittals received by Construction Manager	25 Days After Notice of Award
All Shop Drawings received by Construction Manager	45 Days After Notice of Award
Provide Detailed Construction Schedule	15 Days After Notice of Award
Mobilize	01/30/19
Construction Completed by	11/17/20
Final Cleanup, Punchlist, and Closeout	12/15/20

You agree that failure to meet the date is just cause for the DISTRICT to assess and retain Liquidated Damages in accordance with the Contract Documents.

VIII. CONTRACTOR COMMENTS / SUGGESTIONS:

1. _____
2. _____
3. _____
4. _____
5. _____

Initials: _____

Contractor _____

Construction Manager _____

COMPTON COMMUNITY COLLEGE DISTRICT

IX. CONTRACTOR

The foregoing information is true and accurate, and I am authorized to sign as an office of the company I am representing.

Company Name _____

Signature: _____ Title: _____

Date: _____

X. CONSTRUCTION MANAGER

Signature: _____ Title: _____

Date: _____

XI. Witness:

Signature: _____

Date: _____

END OF SECTION

Initials: _____
Contractor Construction Manager

CONSTRUCTION PROCEDURE MANUAL

COMPTON COMMUNITY COLLEGE DISTRICT

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

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COMPTON COMMUNITY COLLEGE DISTRICT

Construction Procedures Manual

I. INTRODUCTION

This Construction Procedures Manual has been developed for the Compton Community College District.

The purpose of this Manual is to provide the Owner, the Architect, Engineer, Inspector and Contractors detailed information concerning the specific project requirements and procedures.

This manual delineates lines of authority and responsibility of the team members associated with this Project.

Questions or suggested changes to this manual may be addressed to the Construction Manager, at 1111 E. Artesia Blvd., Compton, CA 90221

SHOULD INCONSISTENCIES OR DISCREPANCIES EXIST BETWEEN THIS MANUAL AND THE CONTRACT DOCUMENTS (INCLUDING THE GENERAL CONDITIONS); THE CONTRACT DOCUMENTS (INCLUDING THE GENERAL CONDITIONS) WILL TAKE PRECEDENCE.

COMPTON COMMUNITY COLLEGE DISTRICT

Construction Procedures Manual

II. PROJECT PROCEDURES

A. COMMUNICATIONS

1. In carrying out the terms of the Contract, the Owner and the Architects/Engineer will interact with the Contractors through the Construction Manager.
2. All correspondence, shop drawings, submittals, RFIs etc. are to be processed and submitted through the Construction Manager.
3. All correspondence, shop drawings, submittals, RFIs etc. shall reference the Project by name and Contract number.
4. The Construction Manager is the point of contact for all Project communications.

B. MEETINGS

1. **Pre-Construction Meeting** - (Section 01 31 00)*

After award of the Contract, the Construction Manager will schedule a "Pre-Construction Meeting" to be held at a time and location designated by the Construction Manager. **An authorized representative of Contractor MUST attend the "Pre-Construction" meeting.** Minutes of the meeting will be prepared and distributed by the Construction Manager

2. **Weekly Project Meeting** - (Section 01 31 00)*

- a. The Construction Manager will conduct a weekly Project meeting in the on site office.
- b. Contractor with crews on site and upcoming work must attend weekly meetings.
- c. Persons required to attend the weekly Project meetings include Contractor's supervisory personnel, subcontractor personnel, (as appropriate), the Construction Manager, A/E, and others as requested by the Construction Manager. The Owner or User personnel may attend at any time.

COMPTON COMMUNITY COLLEGE DISTRICT

Construction Procedures Manual

- d. The Contractor(s) shall bring any documentation as may be required in order to accomplish a joint review and status of the Project activities.
- e. Contractor(s) shall prepare a two week "look ahead" schedule for review at each meeting. The schedule shall be prepared in accordance with the scheduling section of this manual and will be reviewed with the contract schedule at each weekly meeting.

3. Special Project Meetings

The Construction Manager may call a Special Project Meeting at any time during the course of the Project. Special Project Meetings, if deemed necessary, shall include representatives of the Contractor(s) and subcontractors as requested in order to provide an adequate line of communication to discuss problems and/or solutions that are common to the Project.

C. SITE RULES

1. The Compton Community College District Campus is Non-Smoking and Drug Free.
2. The Compton Community College District Campus is alcohol free.
3. All personnel are required to wear appropriate protective clothing, work shoes, and safety equipment at all times.
4. All personnel shall restrict their behavior, their language and their demeanor so as to avoid harassment to students and faculty.
5. Violations of Site Rules may result in permanent banning from the Project.

D. PROJECT DOCUMENTS All Construction Manager Document Control will be administered utilizing Prolog 9.5 (or later) software.

1. SUBMITTALS - (Specification Section 01 33 00)*

- a. Contractor shall submit all shop drawings, samples and product data through the Construction Manager within the time requirements set forth in the General Conditions.

* References are to Specification Sections; refer to section for more detailed requirements.

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- b. Every Submittal shall be made to the Construction Manager at the Project site, using the enclosed submittal form. A separate form must be filled out for each submittal. At a minimum, every submittal shall contain the following information and any other information required by the General Conditions:
1. Project Name
 2. Contractors Name & Address
 3. DSA Application Number _____ and File Number _____ for each school.
 4. Submittal Number according to the Submittal Registry.
 5. Submittal Date
 6. Specification and/or Drawing Reference.
 7. Contractor Name and Address
 8. Index of Items Submitted
 9. Number of Copies.

Each submittal must be complete in all forms to allow review without further contact with the Contractor.

- c. **CONTRACTOR WILL STAMP AND SIGN SUBMITTALS, SHOP DRAWINGS, ETC. THAT HE HAS REVIEWED THE ITEMS SUBMITTED, AND CERTIFIES THE ITEMS ARE IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, AND THAT EACH HAS BEEN CHECKED FOR DIMENSIONS AND RELATIONSHIPS WITH WORK OF ALL OTHER CONTRACTORS AND TRADES INVOLVED.**
- d. Upon receipt, the Construction Manager will log each submittal. The Construction Manager may reject any submittal if it is, in his or her judgment, incomplete or inadequate. In such case, one copy of the rejected submittal will be retained by the Construction Manager with remaining

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

copies returned to the Contractor with the reason for rejection cited.

- e. All Submittals shall be numbered by the Contractor as follows:

Start with the Submittal number, followed by the complete specification section number of the item submitted. For example, assuming Reinforcing Steel is required by Specification Section 00 33 00.3.2 and it is the first submittal, the Submittal number for this example is: 0001-003300.2.3. In the event there is a revision required to a submittal, the re-submittal uses the same number as the original, appended with "Rev. 1". The Submittal example then would read: 0001-003300.2.3 - Rev. 1.

- f. Upon completion of the preliminary review, the Construction Manager will transmit acceptable submittals to the A/E for review and comment.

E. A/E REVIEW COMMENTS

- 1. The A/E will review all submittals and, where appropriate, make written commentary. The A/E's comments will be similar to the following:
 - a. "NO EXCEPTIONS TAKEN" - the Contractor may proceed with work covered by the submittal.
 - b. "MAKE CORRECTIONS NOTED" - The Contractor may proceed with the work, provided the Contractor proceeds in accordance with the notes and comments on the submittal.
 - c. "REVISE and RESUBMIT" - the Contractor shall NOT begin any work covered by the submittal until a revision or correction to the submittal has been re-submitted, reviewed and returned to the Contractor.
 - d. "REJECTED" - the Contractor shall not begin any work covered by the submittal until a new submittal has been prepared, submitted and reviewed.

F. SUBMITTAL & SHOP DRAWING QUANTITIES

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Construction Procedures Manual

1. Submittals, Shop Drawings and Product Data shall be submitted in the following minimum quantities:
 - a. SAMPLES: Three or more samples.
 - b. SHOP DRAWINGS: One (1) reproducible and seven (7) copies.
 - c. PRODUCT DATA: Seven (7) copies.

G. DISTRIBUTION OF REVIEWED SUBMITTALS

1. SHOP DRAWINGS - Seven Sets
One (1) reproducible and One (1) copy to Contractor
One (1) copy retained by Architect
One (1) copy retained by the Consultant/Engineer
One (1) copy retained by the DSA Inspector
Two (2) copies to the Construction Manager
One (1) copy to the District
2. PRODUCT DATA - Seven Sets
Three (3) sets to Contractor
One (1) copy retained by Architect
One (1) copy retained by the Consultant/Engineer
One (1) copy retained by the DSA Inspector
One (1) copy to the Construction Manager

If Contractor requires additional reviewed copies of shop drawings or product data, he shall print copies from the reproducible at Contractor's expense.

Fabrication or other work performed in advance of receipt of reviewed drawings, samples or test certifications will be entirely at the Contractor's risk.

H. REQUEST FOR INFORMATION (RFI)

Should the Contractor(s) require clarification or additional information of the plans or specifications, he will direct the request to the Construction Manager on the RFI form as provided by the Construction Manager. Sample forms are in the appendix.

Each RFI will be numbered sequentially. Contractor shall be responsible for maintaining his own "log". The Construction Manager will maintain the

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

Construction Manager's RFI log, and each week, the Construction Manager RFI Log will be distributed & discussed at the weekly meeting.

The RFI shall describe thoroughly, the problem or clarification being requested and a suggested solution. The description provided should be adequate and complete to permit a written response without additional communication with the Contractor. The Contractor shall attach related sketches, information or correspondence which may have been received from subcontractors or vendors on the subject. Each attachment to the RFI shall have the RFI # marked plainly on the attachment pages are to be numbered "Page ___ of ___." In instances where the Contractor believes there may be a conflict between elements of the plans and specifications, he should identify the conflict and indicate the manner in which he interpreted the sections in preparing his bid.

No RFI will be accepted without proper reference to Plan Drawings, Shop Drawings and / or Specification Sections, and all areas completely filled out.

The contractor shall list potential solutions to expedite resolution by the Architect and Owner and the contractor shall insure that all line items in the RFI Form are completely filled out before submitting to the Construction Manager.

The Construction Manager will review the RFI and will either:

1. Return the RFI to the Contractor for additional information or response.
2. Forward the RFI to the Architect of Record for response, copying the Project Inspector in accordance with the below timelines.
3. Provide the response within twenty-four (24) hours and return to the Contractor, with copies to the Architect of Record and Project Inspector. RFI's answered by the CM are logged as official RFI's and subject to all of the below conditions.

The timeline scenario for a routine RFI shall be as follows:

1. CM will verify all RFI's for format and content prior to any disposition and may return to sender for edit, clarification and completeness.
2. When a Contractor submits an RFI to the CM it must be reviewed within twenty-four (24) hours. If the RFI is deemed legitimate by

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the CM and In the event that the CM is not able to adequately answer the RFI in the twenty-four (24) hour period it must be immediately transmitted to the Architect of Record.

3. Once the Architect receives the RFI from the CM, he must respond or pass the RFI on to the proper consultant within three (3) days. (In a Modernization project, the Architect must answer or pass the RFI on to a Consultant with in twenty-four (24) hours.)
4. Consultants are given a maximum of seven (7) days to respond or show cause for delay. (For a Modernization Project this period is shortened to three (3) days.)
5. The appropriate recipient of the RFI will endeavor to provide the response as soon as possible within the above time constraints.
6. When the Construction Manager receives a response back from the Architect, the answer should be reviewed and transmitted to the Contractor as soon as possible and within twenty-four (24) hours. A sixty (60) minute turnaround is preferred.
7. All RFI's properly executed, answered and reviewed must be posted on plans within twenty-four (24) hours of receipt by the CM.
8. In the event an RFI goes unanswered for a period of thirty (30) days or longer it shall be subject to weekly habeas corpus hearings, in which the CM, Architect, Project Inspector, and appropriate Consultant shall attend.

RFI's requiring critical response timing shall be duly annotated as to the urgency of the response date.

If the RFI review indicates a change or revision is necessary to the Contract Documents, the A/E will prepare appropriate drawings and/or specifications required to define the change or revision.

If the Contractor believes the clarification or direction provided by the response to the RFI will impact the cost or schedule of the Project, he shall provide prompt notification thereof to the Construction Manager in accordance with the General Conditions. Upon notification thereof to the Construction Manager, the Contractor shall prepare an Allowance Usage Request or Proposed Change Order, if approved by the District thru the Construction Manager, which shall be processed as outlined in the Change Order Procedure of this manual. In the event the Contractor fails

COMPTON COMMUNITY COLLEGE DISTRICT

Construction Procedures Manual

to notify the Construction Manager, no consideration will be given to the Contractor for additional costs as outlined in the Change Order Procedure.

See also Project Coordination Section (01 31 00, 1.06 Requests for Information) regarding frivolous Requests for Information.

I. SCHEDULES

The Contractor shall furnish to the Construction Manager any required schedules that addresses the work in his Contract(s) in accordance with the General Conditions. The schedules shall be in a format as approved by the Construction Manager, and as a minimum, shall include, without limitation, the following (see also General Conditions):

1. Detail of activities required for their mobilization and start of construction.
2. Activities of other Contractors which must be completed prior to starting various components of other work.
3. A plan for completion of work in sufficient detail to allow observation and monitoring by the Construction Manager. Any activity longer than five (5) working days shall be broken down into phases of five (5) working days or less in length.
4. List activities which must be complete for succeeding contractors to start their work.
5. Show submittals and shop drawing preparation and review time.
6. Long lead procurement requirements.
7. Include all necessary and required DSA Inspections in Schedule.

The Contractor shall prepare schedules in a Critical Path Method (CPM) format as required by the General Conditions. Contractor will review the logic and duration of activities affecting his work. The Construction Manager will conduct a meeting with Contractor(s) to incorporate revisions and issue the approved construction schedule.

The schedule will become the basis for determining completion of the Project and will be reviewed at each weekly meeting.

Contractor will prepare and submit at each weekly meeting a Short Interval Schedule (SIS). The SIS shall be a two (2) week Projection of

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

activities currently in progress or to be started within the following two (2) week period (use form within this manual).

The SIS will be reviewed against the base Contract Schedule each week to evaluate the progress of the work. Contractor shall submit a recovery schedule in the event his work falls behind the approved construction schedule.

J. INSPECTION & TESTING

Contractor shall be responsible for maintaining the necessary licenses required for the completion of the work.

The Owner will pay for State assessed plan check fees and inspection fees, unless otherwise indicated.

Contractor and Subcontractor will be responsible for obtaining and paying for any required City Business licenses.

The on-site DSA Inspector will make normal building and code compliance inspections. Contractor will be responsible for compliance with all requirements of applicable codes per the Contract Documents. Contractor shall inform the Construction Manager at least 2 working days prior to scheduling required inspections. Use Inspection Request Form supplied in the appendix of this manual and also complete and submit the required DSA Form 156.

Inspection, testing, and sampling will be performed as specified in the General Conditions and the specific divisions of the Contract Documents. The Owner, through the Construction Manager, will contract for performance of soil, concrete, steel, grout and mortar testing. Review the Contract Documents for Contractor testing and sampling requirements. In all cases where testing is being performed or samples being taken, the Construction Manager will be given notification pursuant to Contract Document requirements. Contractor shall also timely request special inspections as required by DSA and complete and submit the required DSA verified report forms.

If inspection or testing discloses errors, omissions, inconsistencies, or deficiencies during construction activities, the Contractor will be immediately notified using the "Notice of Non-Conforming Work" form. If corrective action is not apparent, the Construction Manager may request the Contractor to propose a corrective action plan.

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

Where utilities (electric, water, drainage, sewer, gas, etc.) must be disrupted by construction activity, each Contractor shall notify the Construction Manager in writing at least fourteen (14) calendar days prior to the disruption, to be reflected on the 2 Week Look Ahead Schedule.

All **INSPECTION REQUESTS** will be channeled through the Construction Manager to the DSA Inspector (PI). The Construction Manager shall log and monitor time, date and subject of all Inspection Requests utilizing an Inspection Log, and maintaining a binder additionally containing copies of above completed form, as well as copies of Inspection Request Response form executed by the PI. Photographs of area or items to be inspected will be taken and kept as part of the permanent daily record of the project. Inspection log must indicate the title/number of the photos and their permanent file location.

K. VERIFIED REPORTS are required.

Each Contractor shall submit the required DSA Verified Reports to the Construction Manager at the end of construction or as otherwise required by DSA.

Three (3) copies of the report with **Blue ink wet signatures** shall be submitted. Retention may not be paid if Verified Reports are not received. The Construction Manager will transmit the completed Verified Reports to the Inspector for transmittal to DSA and the Architect. Use DSA-6 form supplied in appendix or any updated form from DSA at the completion of the project. The Contractor is also required to submit any other required DSA Verified Reports during construction of the project as required by DSA.

L. SAFETY

Contractor shall have sole and complete responsibility for initiating, maintaining and supervising all safety precautions and programs in connection with this Project. In no case shall the Owner, the Construction Manager, the Architect, the Inspector or their agents, employees or representatives, have either direct or indirect responsibility for the means, methods, techniques, sequences or procedures utilized by the Contractor, or for safety precautions and programs in connection with the work.

Contractor will provide the Construction Manager a copy of his updated safety program prior to commencing the work.

Contractor must submit a Safety Plan to the District via the Construction Manager within thirty five (35) calendar days of the issuance of the Notice

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to Proceed per the General Conditions (Specification 00 72 00). Contractor will conform to all OCIP Regulations **where applicable**.

M. CHANGE ORDER AND ALLOWANCE USAGE PROCEDURE (Specification Section 00 72 00 Article 9)

The Owner, through the Construction Manager, may from time to time direct the Contractor to make changes in the work within the general scope of the Contract. All changes to the Contract will be implemented through written orders or directives prepared by the A/E and issued by the Construction Manager.

When the Construction Manager believes a change order to the construction documents is required that may involve a change in time or cost, he will request the A/E prepare a Bulletin and issue it to the Construction Manager. The A/E will sequentially number and date each Bulletin. The Construction Manager will attach an Allowance Usage Request (AUR) or Potential Change Order (PCO) form to the Bulletin requesting the Contractor to submit a proposal. The Proposal will fully describe the proposed change(s) to the Contract Documents, including sketches, new drawings, or revised specifications as required. The Construction Manager will maintain a log of all AUR/PCOs issued. The Construction Manager shall number each AUR/PCO. Sample AUR/PCO forms and work sheet are in the appendix.

Should the Contractor believe that conditions have changed or he has been directed to do additional work requiring a change in time or cost, he may request the Construction Manager to prepare a AUR/PCO delineating the changed condition along with the cost and/or time impact. If the Contractor intends to make claim for a change in the contract time or cost, he must give the Construction Manager written notice per contract documents after the occurrence of the event giving rise to the claim, or lose his rights to the cost recovery of the extra work arising from the claim.

Upon return of the AUR/PCO the Construction Manager will evaluate the Contractor's quotation for the work, using an estimate of time and cost impact prepared by the A/E or the Construction Manager. If the quotation is acceptable to the Construction Manager, the proposal will be forwarded to the Owner and the A/E. If the quotation is judged by the Construction Manager to be not acceptable, he will begin negotiations with the Contractor to come to an agreement as to the time and cost impact.

The Construction Manager reserves the sole right to notify the Contractor when there will be no further negotiations, and when an impasse exists

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

between the Contractor and the Construction Manager and the work is declared to be in dispute.

The Owner and the Architect may issue through the Construction Manager an AUR/PCO which directs the Contractor to proceed with a change which will be included on a subsequent Change Order. The routing procedure will be the same as a change order. If the AUR/PCO directs work to proceed prior to agreement on a lump sum quotation, the Contractor shall prepare an Extra Work Report **each day** for signature by the Construction Manager and/or the Inspector. **Extra Work tickets not signed daily will not be paid for.**

The DSA and Architect must approve all Change Orders. The Construction Manager will review each Allowance Usage Request or Proposed Change Order with the A/E to determine the appropriate DSA approval process and whether the Change Order is a Category A (DSA Form 140) or Category B (DSA Form 141) Construction Change Document. The Contractor must comply with all DSA requirements for Change Orders and Construction Change Documents.

N. APPLICATION FOR PAYMENT

Application for Payment shall be made by the Contractor on a **monthly** basis for work completed on or before the **25th of each month.**

All Applications for Payment shall contain the approved detailed Schedule of Values submitted by the Contractor at the time of award. Applications shall be submitted on forms provided in the appendix. **No other form will be accepted.**

No later than the 25th of each month, Contractor shall submit a "Preliminary Pay Request" (pencil copy) to the Construction Manager for review. Only the Schedule of Values need be submitted. The "Preliminary Pay Request" shall include a detailed Schedule of Values showing percentages of work complete or scheduled to be complete through the end of the month. The Construction Manager, the A/E and Inspector will review and evaluate the "Preliminary Pay Request". Upon agreement of the amounts due the Contractor, the Contractor will prepare the Application for Payment, and submit seven (7) original copies (wet signature) of the Application to the Construction Manager, last working day of the month, for signatures by the Architect and the Inspector. After signatures are obtained, the Construction Manager will submit the Applications to the District for payment. The District will process the Application.

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Payment for materials delivered to the Project site but not yet incorporated in the work may be made, at the discretion of the Owner. Such materials must be stored at the Project site, properly stacked, crated, boxed, and, if necessary, covered and protected from weather. Documentation of cost shall be provided with the payment request for materials. No payment will be considered without the required documentation. See additional requirements in the General Conditions.

Change Orders, if applicable, shall not be billed until approval of school board is received.

EVERY pay application must be accompanied by a **CONDITIONAL Lien Release for the current application, and an UNCONDITIONAL Lien Release for the prior application. All Applications and Releases are to be NOTARIZED, and signatures are to be in BLUE ink.**

O. PAY ESTIMATE CHECK OFF PROCEDURE (INTERNAL)

1. Verify all Schedule of Values shown on second page agrees with Schedule of Values submitted by Contractor at start of Project.
2. Check all upper details, both pages, are correctly filled in, i.e. Contractor Name and Address, complete Project Name, Architect Name, pay period dates, and that contract date is shown. (Date of Contract Agreement.)
3. Verify all previous information is correctly transferred from last prior estimate. Verify all math calculations are correct on page two and the correct numbers are transferred to page one. Verify all math on estimate page #1.
4. Verify all approved Change Orders have been included in the estimate.
5. Verify Contractor signatures and notary signatures and stamp are on page #1.
6. Verify there is a Conditional Lien Release for the current payment request. If there has been a previous pay request, then verify there is also an Unconditional Lien Release for the previous estimate. These releases must be filled out and signed by the Contractor. The District will not pay if the releases are not in order.

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7. Verify Preliminary Notice information against amounts billed and Request Lien Releases as necessary.
8. As-built drawings are updated and approved by PI.
9. Signed Verification of Certified Payroll Records Submittal to Labor Commissioner Form received.
10. OCIP clearance is obtained – no outstanding issues.
11. Once all of the above is correct, then transfer the complete original to the Construction Manager for signatures by the Architect and the PI. The Architect should be available for signatures, within a reasonable time.
12. After all signatures are obtained, CM signs as approved for payment, then copy for PCM3 file, attach a Letter of Transmittal and have Construction Manager take to district with spread sheet showing all estimates to date for signature by District and distribution to Accounting Department.

P. POSTING OF PROJECT DOCUMENTS (PLANS AND SPECIFICATIONS)

1. All Construction Managers will maintain an up-to-the-day posted set of plans and Specifications for each project at all times. This is essential to the continuity of the project during construction and for archiving purposes. This "Posted Set" shall not leave the Construction Trailer for any reason, and must be kept in a secure location and scrupulously maintained and preserved at all times.
2. Posting must be done within (24) twenty-four hours of the receipt of a completed, signed, change to the Contract Documents.
3. Items that must be posted:
 - a. All addendums to the bid set
 - b. All Requests for Information (RFI)
 - c. All Instructional Bulletins (IB)
4. For consistency the following color scheme for posting shall be followed throughout the District:

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- a. All pre-bid addendums to the bid set shall be posted on YELLOW paper.
 - b. All RFI's will be posted using 50% reduction and PINK paper.
 - c. All Instructional Bulletins will be posted using 50% reduction and GREEN paper.
5. All postings should be sufficiently clear and concise enough to indicate a definitive change to the bid documents. Postings that implement changes on more than one plan sheet or specification page must be posted in the multiple locations or a reference to that posting must be made, sufficient to guide a user to a substantial and correct conclusion.

Note: Use of 50% reduction is a vehicle for saving space. All postings should be located on the plan sheet or in the Specification Section referred to in the posted document. If frequency of posting is such that more room is needed it is permissible to insert blank sheets into the plans or blank pages into the Specifications. Posting on the reverse of the preceding plan sheet is not advised due to the possibility of replacement sheets.

Q. ITEM OF CHANGE (IOC) LOG TO BE KEPT AND MAINTAINED BY CONSTRUCTION MANAGER.

1. All changes to the Contract Documents are to be logged under separate cover in an Items of Change (IOC) Log and maintained on a continual updated basis.
2. Items in the IOC Log must correspond to items included in the Schedule of Values and be valuated based on given costs or good faith estimates.
3. The IOC Log matrix should include, but be not limited to: Item Number; Date; Description; Budget Revision; checklist for necessary Approvals; and indication of Inclusion in a Change Order.

END OF SECTION

**COMPTON COMMUNITY COLLEGE DISTRICT
Construction Procedures Manual**

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COMPTON COMMUNITY COLLEGE DISTRICT Daily Construction Job Report

School Site: _____

CONTRACTOR _____

WEATHER _____

SUPT. /FOREMAN _____

<i>DATE</i>

Time Work Started _____

Time Work Ended _____

WORK FORCE		Number of Hours					
WORKERS	NAME	Foreman	Journeyman	Apprentice	Laborer	Operator	Other
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.						TOTAL	HOURS
14.							
15.							

WORK DONE and MATERIALS DELIVERED

**COMPTON COMMUNITY COLLEGE DISTRICT
Construction Procedures Manual**

SUBMITTAL FORM

CM # _____ (For CM Use Only)

**CCCD Bond Trailer
PCM3, Inc.
1111 E. Artesia Blvd.
Compton, CA 90221**

**PROJECT: Student Services Building
PROJECT NO: RFQ CCC-XXX**

SUBMITTAL

SUBMITTAL # _____

DATE: ____ / ____ / ____ **TITLE/Description:** _____

SPECIFICATION SECTION or DRWG. # : _____ **NO. COPIES SUBMITTED:** _____

NO. COPIES RETURNED: _____

TO: _____

DSA FILE NO: _____

CONTRACTOR: _____

ADDRESS: _____

DSA APP. NO: _____

PHONE: _____

ATTN.: _____

CONTRACTOR CERTIFIES: We have reviewed the attached submittal verifying products in this submittal, dimensions, adjacent work, and coordination of information is in accordance with the requirements of the work and contract documents, and approve this submittal (Reference Section 01330).

BY: _____
Contractor's Representative

DATE: ____ / ____ / ____

FOR USE BY ENGINEER:

ENGINEER'S STAMP:

- ____ **NO EXCEPTIONS TAKEN**
- ____ **MAKE CORRECTIONS NOTED**
- ____ **REVISE & RESUBMIT**
- ____ **REJECTED**

REMARKS: _____

COMPTON COMMUNITY COLLEGE DISTRICT
Construction Procedures Manual
SUBSTITUTION REQUEST FORM (AFTER BID)
Construction Manager # _____ (For CM Use Only)

DATE: _____ BID PACKAGE: _____

TO: _____

PROJECT: Student Services Building
 SPECIFIED ITEM:

Section	Page	Paragraph	Description
---------	------	-----------	-------------

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request. Applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents which the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs and any additional requirements in the General Conditions Article 3.10, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on drawings:
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. The proposed substitution is submitted within seven (7) calendar days after issuance of the Notice of Intent to Award.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by: _____

Signature _____

Firm _____

Address _____

Remarks _____

Date _____

Telephone _____

Fax: _____

Date: _____

(For Use By The Design Consultant)

___ Accepted ___ Accepted as noted

___ Not Accepted ___ Received too late

Reviewed By _____

COMPTON COMMUNITY COLLEGE DISTRICT

INSPECTION REQUEST

DATE:	CONTRACTOR:
--------------	--------------------

SUB-CONTRACTOR/ TRADE: (if any)

DESCRIPTION OF REQUIRED INSPECTION:

INSPECTION LOCATION:	DATE REQUIRED:
	TIME REQUIRED:
PHONE:	

REQUESTED BY:	DATE:
TITLE:	SPECIAL INSTRUCTIONS:
SIGNATURE:	BATCH PLANT INSP. REQ'D: YES NO

INSPECTORS COMMENTS:	
DATE:	SIGNATURE:

SUBMIT TO (CM), 2 WORKING DAYS PRIOR TO DATE & TIME REQUIRED.

DATE & TIME RECEIVED BY CM:
CM. PROJECT MANAGER:

cc: CM File

**COMPTON COMMUNITY COLLEGE DISTRICT
REQUEST FOR INFORMATION**

PCM3 # _____ (For PCM3 Use Only)

(ALL LINE ITEMS MUST BE COMPLETED PRIOR TO SUBMITTAL)

TO: Construction
 Manager Ref No. :

RFI No. _____-_____ RFI No. Bid Pkg.

FROM: _____

DWG. REF. : _____

EMAIL _____

SCHOOL _____

Spec. Ref: _____

Bid Pack: _____

Date: _____

Trade not BP No.

Description of Problem / Clarification / Information Required:

Drawings attached -

Proposed Solution:

Question By: _____

Date: _____

Response: _____

Response By: _____

Date: _____

Reviewed By: _____

Date: _____

COMPTON COMMUNITY COLLEGE DISTRICT

REQUEST FOR QUOTATION FORM

Project : RFQ CCC-000 Student Services Building

RFQ NO.: _____

DATE ____ / ____ / ____

BID PACKAGE NO.: _____

TO:

Please submit price quotation for the following work:

(Support Quotation with detailed cost breakdown and back-up materials.)

Reference Document, if any: _____

Price Quotation needed by: _____

Request submitted by: _____ **DATE:** ____ / ____ / ____
Construction Manager.

Parties agree and acknowledge the information in this Request for Quotation is for review purposes only. This Request for Quotation is not a request for, nor an authorization of additional work or an extension of the Contract period.

COMPTON COMMUNITY COLLEGE DISTRICT

ALLOWANCE USAGE REQUEST

CM # _____

PROJECT: RFQ CCC-XXX Student Services Building

ALLOWANCE USAGE REQUEST — AUR# _____

TO: _____

DATE ISSUED: _____

FROM: _____

PRICING DUE BY: _____

PROJECT No.: _____

PROJECT NAME: _____

Please submit an itemized quotation for change in the contract sum and time incidental to the proposed modifications to the Contract Documents as described herein. Cost breakdown format shall be as specified including all back up documentation.

Change Item: _____

**THIS IS NOT A CHANGE ORDER NOR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED HEREIN.
REFERENCE RFQ# _____ DESCRIPTION OF AUR:**

REQUESTED BY: A. Architect B. DSA Inspector C. Contractor D. Owner

COST IMPACT: A. NONE B. DEDUCT: \$ _____ C. ADD: \$ _____

TIME IMPACT: A. NONE B. DEDUCT _____ DAYS C. ADD: _____ DAYS
Submit justification for time impact per Article 9.5 in the General Conditions 00 72 00

APPROVAL OF THE AUR BY ALL PARTIES LISTED BELOW SERVES AS A NOTICE TO PROCEED.

cc: Contractor: BY: _____

District: BY: _____

Architect/Engineer BY: _____

Project Inspector BY: _____

Construction Manager BY: _____

COMPTON COMMUNITY COLLEGE DISTRICT

POTENTIAL CHANGE ORDER
CM # _____

PROJECT: CCC-XXX Student Services Building

POTENTIAL CHANGE ORDER — PCO# _____

TO: _____ DATE ISSUED: _____

FROM: _____ PRICING DUE BY: _____

PROJECT No.: _____ PROJECT NAME: _____

Please submit an itemized quotation for change in the contract sum and time incidental to the proposed modifications to the Contract Documents as described herein. Cost breakdown format shall be as specified including all back up documentation.

Change Item: _____

THIS IS NOT A CHANGE ORDER NOR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED HEREIN.
REFERENCE RFQ# _____ DESCRIPTION OF PCO:

REQUESTED BY: A. Architect B. DSA Inspector C. Contractor D. Owner

COST IMPACT: A. NONE B. DEDUCT: \$ _____ C. ADD: \$ _____

TIME IMPACT: A. NONE B. DEDUCT _____ DAYS C. ADD: _____ DAYS
Submit justification for time impact per Article 9.5 in the General Conditions 00 72 00

APPROVAL OF THE PCO BY ALL PARTIES LISTED BELOW SERVES AS A NOTICE TO PROCEED.

cc: Contractor: BY: _____

District: BY: _____

Architect/Engineer BY: _____

Project Inspector BY: _____

Construction Manager BY: _____

COMPTON COMMUNITY COLLEGE DISTRICT

**Allowance Usage Request/Proposed Change Order
CHANGES AND EXTRAS FORM**

The following format shall be used, as applicable by the District and the Contractor to communicate proposed additions and deductions to the Contract. A copy of the Allowance Usage Request and Proposed Change Order form is provided at the end of this Article.

	<u>EXTRA</u>	<u>CREDIT</u>
(a) Material (attach itemized quantity and unit cost plus sales tax)	_____	_____
(b) Labor (attach itemized hours and rates)	_____	_____
(c) Equipment (attach invoices)	_____	_____
(d) Subtotal	_____	_____
(e) For Proposed Change Order and Allowance Usage Request: If Subcontractor performed Work, add Subcontractor's overhead and profit to portions performed by Sub-contractor, not to exceed fifteen percent (15%) of item (d).	_____	_____
(f) Subtotal	_____	_____

COMPTON COMMUNITY COLLEGE DISTRICT

	<u>EXTRA</u>	<u>CREDIT</u>
(g) For Proposed Change Order: General Contractor's Overhead and Profit: Not to exceed fifteen percent (15%) of Item (d) if Contractor performed the work. No more than five percent (5%) of Item (f) if Subcontractor performed the work. If work was performed by Contractor and Subcontractors, portions performed by Contractor shall not exceed fifteen percent (15%) if Item (d), and portions performed by Subcontractor shall not exceed five percent (5%) of Item (f)		
For Allowance Usage Request: Zero (-0-) percent markup per General Conditions Specification Section 00 73 00 paragraph H	_____	_____
(h) Subtotal	_____	_____
(i) For Proposed Change Order: Bond not to exceed one percent (1%) of Item (d)		
For Allowance Usage Request: Zero (-0-) percent bond per General Conditions Specification Section 00 73 00 paragraph H.	_____	_____
(j) TOTAL	_____	_____
(k) Date / Time	_____	_____

The undersigned Contractor approves the foregoing Allowance Usage Request or Proposed Change Order as to the changes, if any, and the contract price specified for each item and as to the extension of time allowed, if any, for completion of the entire work on account of said Allowance Usage Request or Proposed Change Order, and agrees to furnish all labor, materials and service and perform all work necessary to complete any additional work specified therein, for the consideration stated herein. It is understood that said Allowance Usage Request or Proposed Change Order shall be effective when approved by the Governing Board of the District.

COMPTON COMMUNITY COLLEGE DISTRICT

It is expressly understood that the value of such extra Work or changes, as determined by any of the aforementioned methods, expressly includes any and all of the Contractor's costs and expenses, both direct and indirect, resulting from additional time required on the Project or resulting from delay to the Project. Any costs, expenses, damages or time extensions not included are deemed waived.

The Contractor expressly acknowledges and agrees that any change in the Work performed shall not be deemed to constitute a delay or other basis for claiming additional compensation based on theories including, but not limited to, acceleration, suspension or disruption to the Project.

INSTRUCTION SHEET

A. GENERAL INFORMATION:

The Payment Application and the Schedule of Values Sheet are designed to be used on a project where a Contractor has a direct Agreement with the Owner. **No Pay Applications will be accepted without updated approved "As-Builts".**

B. COMPLETING THE PAYMENT APPLICATION:

After the Contractor has completed the Schedule of Values Sheet, summary information should be transferred to the Payment Application.

The Contractor should sign the form have it notarized and submit it, together with the Schedule of Values, to the Architect. Seven signed, notarized originals should be submitted.

The Architect should review it and, if it is acceptable, complete the Architect's Certificate for Payment on this form. The completed form should be forwarded to the Owner.

C. COMPLETING THE SCHEDULE OF VALUES SHEET:

Heading: Complete the information here consistent with similar information on the Payment Application.

Columns A, B & C: These columns should be completed by identifying the various portions of the project and their scheduled value consistent with the schedule of values submitted to the Architect at the commencement of the Project or as subsequently adjusted. The breakdown may be by sections of the Work or by Subcontractors and should remain consistent throughout the Project. Multiple pages should be used when required.

Column C: This column should be subtotaled at the bottom when more than one page is used and totaled on the last page. Initially, this total should equal the original Contract Sum. The total of Column C may be adjusted by Change Orders during the Project.

Column D: Enter in this column the amount of completed Work covered by the previous application. This is the sum of columns D and E from the previous application. Values from column F (Materials Presently Stored) from prior payments should not be entered in this column.

Column E: Enter here the value of Work completed until the time of this Application, including the value of materials incorporated in the project, which were listed on the previous Application and Certificate for Payment under Materials Presently Stored (column F).

Column F: Enter here the value of Materials Presently Stored for which payment is sought. The total of the column **must** be recalculated at the end of each pay period. This value covers both materials newly stored for which payment is sought and materials previously stored which are not yet incorporated into the Project. Mere payments by the Owner for stored materials does not result in a deduction from this column. Only as materials are incorporated into the Project is their value deducted from this column and incorporated into column E (Work Completed—This Period).

Column G: Enter here the total of columns D, E and F. Calculate the percentage completed by dividing column G by column C.

Column H: Enter here the difference between column C (Scheduled Value) and column G (Total Completed and Stored to Date).

Column I: This column is normally used only for contracts where variable retainage is permitted on a line-item basis. It need not be completed on projects where a constant retainage is withheld from the overall contract amount.

Change Orders: Although Change Orders could be incorporated by changing the schedule of values each time a Change Order is added to the Project, this is not normally done. Usually, Change Orders are listed separately, either on their own form or at the end of the basic schedule. The amount of the original contract adjusted by Change Orders is to be entered in the appropriate location of the Payment Application.

D. MAKING PAYMENT

The Owner should make payment directly to the Contractor based on the amount certified by the Architect on the Payment Application. The completed form contains the name and address of the Contractor. Payment should not be made to any other party unless specifically indicated on this form.

APPLICATION AND CERTIFICATE FOR PAYMENT - AIA DOCUMENT G702/CMa (Instructions on next page) Page One of _____ Pages

TO: Compton Community College District
 CCCD PCM3 Bond Trailer
 1111 E. Artesia Blvd.
 Compton , CA 90221

Student Services Building

APPLICATION NO. _____

FROM _____
 ADDRESS _____

PERIOD TO: _____

Distribution to:
 OWNER
 ARCHITECT
 CONTRACTOR
 CONSTRUCTION MANAGER
 PROJECT NO: CCC-XXX

CONTRACT FOR: _____

BID PACKAGE: _____

CONTRACT DATE: _____

CONTRACTOR'S APPLICATION FOR PAYMENT

CHANGE ORDER SUMMARY		ADDITIONS	DEDUCTIONS
Change Orders approved in previous months by Owner			
TOTAL			
Approved this Month			
Number	Date Approved		
TOTALS			
Net change by Change Orders			

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates of Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:
 BY: _____ Date: _____

Application is made for Payments as shown below, in connection with the Contract. Schedule of Values is attached.

1. ORIGINAL CONTRACT SUM _____
2. NET CHANGE ORDERS..... _____
3. CONTRACT SUM TO DATE..... _____
4. TOTAL COMPLETED & STORED TO DATE..... _____
 (Column G on SCHEDULE)
5. RETAINAGE:
 a. ___5___ % Completed Work..... _____
 (Column D + E on SCHEDULE) b.
 ___ % of Stored Material..... _____
 (Column F on Schedule of Values Sheet Total Retainage (Line 5a + 5b or Total in Column 1 of Schedule of Values Sheet)..... _____
6. TOTAL EARNED LESS RETAINAGE (Line 4 less line 5 Total)..... _____
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)..... _____
8. CURRENT PAYMENT DUE..... _____
9. BALANCE TO FINISH, INCLUDING RETAINAGE.. _____
 (Line 3 less Line 6)

State of: _____ County of: _____
 Subscribed and sworn to before me this _____ day of _____, 20____
 Notary Public: _____
 My Commission expires: _____

ARCHITECT'S CERTIFICATE FOR PAYMENT

By: _____ DATE: _____
 INSPECTOR:
 By: _____ DATE: _____
 OWNER: Compton Community College District
 BY: _____ DATE: _____
 CONSTRUCTION MANAGER: PCM3, Inc.

In accordance with the Contract Documents, based on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED \$ _____ Date: _____
 (Attach explanation if amount certified differs from the amount applied for)

tBP

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

APPLICATION FOR PAYMENT
SCHEDULE OF VALUES

Schedule of Values Sheet

Application and certificate for payment containing contractor's signed certification, is attached in tabulations below, amounts are stated to the nearest dollar.
Use column 1 on contracts where variable retainage for line items may apply

Application #	
Application Date	
Period To	
Project #	CCC-XXX

Contractor Name _____

BP # _____

Contractor Name _____			BP # _____								
A	B	C	D		E	F	G	H		I	
			<i>Work Completed</i>								
Item #	Description of Work	Scheduled Value	From Previous Application (D + E)	This Period	Materials Stored (Not in D or E)	Total Completed & Stored To Date (D +E+F)	% (G/C)	Balance Finish G)	To (C-	Retainage (Of Variable Rate)	
1			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
2			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
3			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
4			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
5			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
6			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
7			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
8			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
9			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
10			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
11			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
12			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
13			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
14			-	\$ -	\$ -	\$ -	#DIV/0!	\$ -	-	\$ -	
	Change Orders (Approved)										
Totals		\$ -	\$ -	\$ -		\$ -	#DIV/0!	\$ -	-	\$ -	

COMPTON COMMUNITY COLLEGE DISTRICT

CONDITIONAL WAIVER AND RELEASE UPON PROGRESS PAYMENT [Civil Code §8132]

Upon receipt by the undersigned of a check from _____
(Maker of Check)

in the sum of \$ _____ Payable to _____
(Amount of Check) (Payee or Payees of Check)

and when the check has been properly endorsed and has been paid by the bank upon which it is drawn, this document shall become effective to release any mechanic's lien, stop notice or bond right the undersigned has on the job of Compton Community College District located at _____ to the following extent.

This release covers a progress payment for labor, services, equipment or materials furnished to _____ through _____
(Your Customer) (Date)

only and does not cover any retention retained before or after the release date; extras furnished before the release date for which payment has not been received; extras or items furnished after the release date. Rights based upon work performed or items furnished under a written change order which has been fully executed by the parties prior to the release date are covered by this release unless specifically reserved by the claimant in this release. This release of any mechanic's lien, stop notice, or bond right shall not otherwise affect the contract rights, including rights between parties to the contract based upon a rescission, abandonment, or breach of the contract, or the right to the undersigned to recover compensation for furnished labor, services, equipment, or material covered by this release if that furnished labor, services, equipment, or material was not compensated by the progress payment.

Before any recipient of this document relies on it, said party should verify evidence of payment to the undersigned.

Dated: _____ Company Name: _____

By: _____
(Title)

NOTE: This form complies with the requirements of Civil Code Section 8132. It is to be used by a party who applies for a progress payment when the progress check has not yet cleared the bank. This release only becomes effective when the check, properly endorsed, has cleared the bank.

USE REVERSE SIDE AS RELEASE FOR INDIVIDUALS PERFORMING LABOR FOR WAGES

COMPTON COMMUNITY COLLEGE DISTRICT

§ 484(b) OF THE CALIFORNIA PENAL CODE PROVIDES IN PART AS FOLLOWS:

"Any person who receives money for the purpose of obtaining paying for services, labor, materials or equipment and willfully fails to apply such money for such purpose by wither willfully failing to complete the improvements for which funds were provided or willfully failing to pay for services, labor, materials or equipment provided incident to such construction, and wrongfully diverts the funds to a use other that for which the funds were received, shall be guilty of a public offense and punishable by a fine not exceeding ten thousand dollars (\$10,000), or by imprisonment in the state prison, or in the county jail not exceeding one year, or by both such fine and such imprisonment. If the amount diverted is in excess of one thousand dollars (\$1,000). If the amount diverted is less than one thousand dollars (\$1,000), the person shall be guilty of a misdemeanor."

§484(c) OF THE CALIFORNIA PENAL CODE PROVIDES AS FOLLOWS:

"Any person who submits a false voucher to obtain construction loan funds and does not use the funds for the purpose for which the claim was submitted is guilty of embezzlement."

§206.5 OF THE CALIFORNIA LABOR CODE PROVIDES:

"No employer shall require the execution of any release of any claim or right on account of wages due, or become due, or made as an advance on wages top be earned, unless payment of such wages has been made. Any release required or executed in violation of the provisions of this section shall be null and void as between the employer and the employee and the violation of the provisions of this section shall be a misdemeanor."

§532(e) OF THE CALIFORNIA PENAL CODE PROVIDES AS FOLLOWS:

"Any person who receives money for the purpose of obtaining or paying for services, labor, materials or equipment incident to constructing improvements on real property and willfully rebates any part of the money to or on behalf of anyone contracting with such person for provision of the services, labor, materials or equipment for which the money was given, shall be guilty of a misdemeanor, provided, however, that normal trade discount for prompt payment shall not be considered a violation of this section."

COMPTON COMMUNITY COLLEGE DISTRICT

UNCONDITIONAL WAIVER AND RELEASE UPON PROGRESS PAYMENT

Civil Code Section 8134

The undersigned has been paid in and has received a progress payment in the sum of

\$ _____ for _____
(Amount of Check Written & Numeric)

labor, services, equipment, or material furnished to Compton Community College District on the job of CCCD _____ Project and does hereby release pro tanto any mechanics lien, stop notice, or bond right that the undersigned has on the above referenced job to the following extent. This release covers a progress payment for labor, services, equipment, or material furnish to **Compton Community College District** through _____ only and does not cover any retention retained before of (Date/End of Month) after the release date; extras furnished before the release date for which payment has not been received; extras or items furnished after the release date. Rights based upon work performed or items furnished under a written change order which has been fully executed by the parties prior to the release date are covered by this release unless specifically reserved by the claimant in this release. This release of any mechanic's lien, stop notice, or bond right shall not otherwise affect the contract rights including rights between parties to the contract based upon a rescission, abandonment, or breach of the contract, of the right of the undersigned to recover compensation for furnished labor, services equipment, or material covered by this release if that furnished labor, services, equipment, or material was not compensated by the progress payment.

Date: _____

(Company Name)

(Bid Package Number)

By: _____
(Signature)

(Print Name)

(Title)

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

NOTE: This form of release complies with the requirements of Civil Code Section 8134. It is to be used to release claims to the extent that a progress payment has actually been received by the releasing party.

COMPTON COMMUNITY COLLEGE DISTRICT

**CONDITIONAL WAIVER AND RELEASE UPON FINAL PAYMENT
(Civil Code Section 8136)**

Upon receipt by the undersigned of a check from _____

(Maker of Check)

in the sum of \$ _____

(Amount of Check)

payable to _____

(Payee or Payees of Check)

and when the check has been properly endorsed and has been paid by the bank upon which it is drawn, this document shall become effective to release pro tanto any mechanic's lien, stop notice or bond right the undersigned has on the job of Compton Community College District located at 1111 E. Artesia Blvd., Compton, CA 90221 to the following extent:

This release covers the final payment to the undersigned for all labor, services, equipment, or materials furnished on the _____, except for disputed claims for extra work in the amount of \$ _____.

DATED: _____

(Company Name)

By: _____

(Title)

NOTE: This form complies with the requirements of Civil Code Section 8136. It is to be used by the party who applies for a final payment when the final payment check has not yet cleared the bank. This release only becomes effective when the check, properly endorsed, has cleared the bank.

COMPTON COMMUNITY COLLEGE DISTRICT

2-WEEK-LOOK-AHEAD

1. Insert information, including dates
2. Include Contractor Company Name & Bid Package Number below
3. Include Signature below

Items to Schedule: _____

Date: _____ Signature: _____

Contractor: _____

COMPTON COMMUNITY COLLEGE DISTRICT

TIME AND MATERIAL WORK ITEM TICKET

PROJECT: _____ PCO/AUR# _____
 CONTRACTOR: _____ SHEET# _____ of _____
 Reference Document: _____ Submitted for work on: _____
 Original Work Date for this Item: _____ Is Work Completed today? _____
 Date of Last Work Activity: _____ Date Submitted to CM _____

WORK COMPLETED TODAY:

Location:

LABOR

EMPLOYEE NAME	CLASSIFICATION	Hours Noted	REMARKS
1. _____	_____	_____	_____
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____
5. _____	_____	_____	_____

MATERIAL

ITEM DESCRIPTION	QTY / UNITS	Hours Noted	REMARKS
1. _____	_____	_____	_____
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____
5. _____	_____	_____	_____

EQUIPMENT

EQUIPMENT	MAKE & MODEL	Hours Noted	REMARKS	Rented / Owned
1. _____	_____	_____	_____	_____
2. _____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____
4. _____	_____	_____	_____	_____
5. _____	_____	_____	_____	_____

CONTRACTOR CERTIFICATION: Signature by contractor to certify that all information on this sheet is true and accurate. Contractor also certifies that only the listed labor, material, and equipment listed were used for this item and that no other items are part of this work.

SIGNATURES

CM: Verifies hours worked as identified on this sheet only, not acceptance of any cost or schedule impact on behalf of the Owner.

IOR: Verifies hours worked as identified on this sheet only, not acceptance of any cost or schedule impact on behalf of the Owner.

UNCONDITIONAL WAIVER AND RELEASE UPON FINAL PAYMENT

{Civil Code Section 8138}

The undersigned has been paid in full for all labor, services, equipment or materials
furnished to _____

on the job of _____

located at _____

and does hereby release pro tanto any mechanic's lien, stop notice or bond right, except
for disputed claims for extra work in the amount of \$_____.

DATED: _____

Company Name

By: _____

Signature

Title _____

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE UPON FINAL PAYMENT FORM.

NOTE: This form of release complies with the requirements of Civil Code Section 8138. It is to be used to release claims to the extent that a final payment has actually been received by the releasing party.



COMPTON COMMUNITY COLLEGE DISTRICT
1111 E. Artesia Blvd
Compton, California 90221

GUARANTEE

Guarantee for _____ . We hereby guarantee that the _____, which we have installed in _____, has been done in accordance with the Contract Documents, including without limitation, the drawings and specifications, and that the work as installed will fulfill the requirements included in the bid documents. The undersigned and its surety agrees to repair or replace any or all such work, together with any other adjacent work, which may be displaced in connection with such replacement, that may prove to be defective in workmanship or material within a period of _____ (__) year(s) from the date of the Notice of Completion of the above-mentioned structure by the Compton Community College District, ordinary wear and tear and unusual abuse or neglect excepted.

In the event the undersigned or its Surety fails to comply with the above-mentioned conditions within a reasonable period of time, as determined by the District, but not later than ten (10) days after being notified in writing by the District or within two (2) business days in the case of an emergency or urgent matter, the undersigned and its surety authorizes the District to proceed to have said defects repaired and made good at the expense of the undersigned and its surety, who will pay the costs and charges therefore upon demand. The undersigned and its surety shall be jointly and severally liable for any costs arising from the District's enforcement of this Guarantee.

GUARANTEE (continued)

Contractor's Company Name

Signature of Contractor

Print Name

Title

Subcontractor's Company Name
(If work performed by subcontractor)

Signature of Subcontractor

Print Name

Title

Representatives to be contacted for service:

Name: _____

Address: _____

Telephone Number: _____

END OF SECTION

CONTRACTOR VERIFIED REPORT

This form shall be completed by each contractor having a contract with the owner, in accordance with California Code of Regulations, Title 24, Part 1, Sections 4-343 or 4-220.

School District/Owner:		DSA File #: -
Project Name/School:		DSA App. #: -
Date of Report:	Number of Attached Pages: <i>(If none, enter zero.)</i>	DSA 152 Card #(s):
Note that DSA approved construction documents, referred to below, are those portions of the construction documents, duly approved by the DSA, that contain information related to and affecting the Structural Safety, Fire/Life Safety and Accessibility portions of the project.		<i>List all inspection card numbers for which this verified report applies.</i>

COMPLETE SECTIONS 1, 2, 3 & 4 AND PROVIDE ALL REQUIRED DOCUMENTATION

1. CONTRACTOR INFORMATION *(Enter name and check applicable box)*

Name of Contractor (Company/Firm) Submitting this Report:	
<input type="checkbox"/>	Operating as general contractor responsible for all work shown in the <i>DSA approved</i> construction documents.
<input type="checkbox"/>	Operating as contractor responsible for part of the work shown in the <i>DSA approved</i> construction documents. <i>(Describe scope of work in the contract.)</i>

2. REASON FOR FILING THIS VERIFIED REPORT *(Check applicable box)*

<input type="checkbox"/>	Interim Verified Report: List affected form DSA 152 Inspection Card Section #(s):
<input type="checkbox"/>	Final Verified Report: Construction of all work shown in the <i>DSA approved</i> construction documents that is part of my contract is complete.
<input type="checkbox"/>	Termination of Contract prior to completion of all work in the contract <i>(Provide last date of work):</i>
<input type="checkbox"/>	DSA Request Dated:

3. DEFERRED SUBMITTALS *(Check applicable box)*

<input type="checkbox"/>	This project does not require deferred submittals within the scope of my contract.
<input type="checkbox"/>	All deferred submittals within the scope of my contract are approved by DSA.
<input type="checkbox"/>	The following deferred submittals, within the scope of my contract, are not approved by DSA <i>(Provide list. Attach additional pages if necessary.):</i>

4. DEVIATIONS AS OF THE DATE OF THIS REPORT *(Check applicable box)*

<input type="checkbox"/>	All deviation notices pertinent to my contract related to work shown in the <i>DSA approved</i> construction documents are resolved.
<input type="checkbox"/>	There are unresolved deviation notices pertinent to my contract and related to work shown in the <i>DSA approved</i> construction documents. <i>(Attach copies)</i>
<input type="checkbox"/>	There is work pertinent to my contract that is not completed in compliance with the <i>DSA approved</i> construction documents. <i>(Briefly describe. Attach additional pages if necessary.)</i>

I attest that based on my own personal knowledge (as defined in California Code of Regulations, Title 24, Part 1, Sections 4-336 and 4-214) that, except as marked in Sections 3 and 4, as of the date of this report, the work has been performed and materials have been used and installed, in every material respect, in compliance with the *DSA approved* construction documents. I declare under penalty of perjury that I prepared this report and that all statements are true.

Signature: _____ Date: _____

Print Name: _____ Contractor's License No.: _____

Submit completed form to the DSA Regional Office with construction oversight authority for the project.

<input type="checkbox"/> DSA OAKLAND 1515 Clay Street, Suite 1201 Oakland, CA 94612	<input type="checkbox"/> DSA SACRAMENTO 1102 Q Street, Suite 5200 Sacramento, CA 95811	<input type="checkbox"/> DSA LOS ANGELES 700 N. Alameda Street, Suite 5-500 Los Angeles, CA 90012	<input type="checkbox"/> DSA SAN DIEGO 10920 Via Frontera Rd., Suite 300 San Diego, CA 92127
---	--	---	--

COMPTON COMMUNITY COLLEGE DISTRICT
Construction Procedures Manual

V. PROJECT / CONTRACT COMPLETION

- A. The contracts of certain other Contractors may be complete prior to the overall completion of the project, as determined by the Construction Manager. The entire project is not finally complete until Contractors have completed their work and all equipment and furnishings have been installed, systems tested, and accepted and all notices of completion recorded. The District may occupy all or any part of the project prior to completion, in accordance with the Contract Documents. See General Conditions Article 9.9 for further details regarding project completion and requirements.

END OF SECTION

COMPTON COMMUNITY COLLEGE DISTRICT

Construction Procedures Manual

VI. CONTRACT CLOSE-OUT

A. Contract close-out involves review of the Contract Documents, drawings, specifications, schedules, and inspection reports to ensure the Contractors have satisfactorily completed the requirements of the Contract Documents (General Conditions Article 9.9). Before release of the retainage, the Contractor must deliver to the Construction Manager the following close-out submittals and documentation: Including, but not limited to, the following (see also General Conditions Article 9.11):

1. Certificates of Inspection as applicable to each bid package
2. Project record documents, including as-built documents (Hard and Electronic per the District Requirements)
3. Operation and Maintenance Manuals - (per Contract Documents)
4. Warranties and Bonds - two wet signed notarized originals that MUST be signed with blue ink
5. Keys and keying schedule
6. Spare parts and materials
7. Statement of completion of all punch list items
8. Affidavit that all payrolls, bills, and indebtedness connected with the work have been paid or satisfied - sworn statement
9. Final waiver of liens
10. Consent of Surety to final payment
11. Final Verified Reports
12. Other data as required by the Construction Manager for assurance of satisfaction of the requirements of the contract documents.
13. In-Service Schedule
14. Commissioning

The A/E will make distribution of the close-out submittals to the Owner with copies to the appropriate project team members.

COMPTON COMMUNITY COLLEGE DISTRICT
Construction Procedures Manual

- B. The A/E will draft the Notice of Completion for Board presentation. The District normally files these with the County within ten (10) days of the Board's action.

- C. Upon completion and submittal of all contract close-out times, the Contractor shall submit written notice to the Construction Manager that the project is ready for final inspection. Concurrent with the request for final inspection, the Contractor shall prepare and submit a final application for payment, the Construction Manager, in conjunction with the A/E, will issue a final certificate for payment to the Owner recommending final payment. The Owner will make final payment, less outstanding Stop Notices.

END OF SECTION

COMPTON COMMUNITY COLLEGE DISTRICT Construction Procedures Manual

V. APPENDIX

A. GENERAL FORMS:

1. Daily Construction Job Report
2. Submittal Form
3. Substitution Request Form
4. Inspection Request
5. Request For Information
6. Request For Quotation Form
7. Potential Change Order
8. Change and Extras Form
9. Instruction Sheet for Pay Applications
10. Application and Certification for Payment
11. Schedule of Values Sheet
12. Conditional Waiver And Release Upon Progress Payment
13. Unconditional Waiver And Release Upon Progress Payment
14. Conditional Waiver And Release Upon Final Payment
15. 2-Week-Look-Ahead
16. Time and Material Work Item Ticket
17. Guarantee Form
18. DSA-6 Form

COMPTON COMMUNITY COLLEGE DISTRICT

PROJECT COORDINATION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED:

- A. Each Prime CONTRACTOR shall coordinate his Work and Work of his subcontractors for the Project.
- B. Each Prime Contractor shall:
 - 1. Coordinate work of his own employees and suppliers.
 - 2. Expedite his work to assure compliance with schedules.
 - 3. Coordinate his work with that of other Prime Contractors, subcontractors, and work by DISTRICT.
- C. Each Prime Contractor shall coordinate his work and the work of his subcontractors with other Prime Contractors on Project.
- D. This Prime Contractor understands and will coordinate with Bid Packs 01to ensure proper coordination, scheduling and ensure that the required Fire Watch/Security is well informed and coordinated with the Construction Manager and reviewed at each construction meeting.

1.2 RELATED REQUIREMENTS:

- A. The General Conditions of the Contract: Authority and responsibilities of the Contractor and subcontractor.

1.3 CONSTRUCTION ORGANIZATION AND START-UP:

- A. The Prime Contractor shall establish on-site lines of authority and communications, and each Contractor shall:
 - 1. Attend pre-construction meeting and mandatory weekly progress meetings.
 - 2. Establish procedures for inter-project communications:
 - a. Submittals
 - b. Reports and records
 - c. Recommendations

COMPTON COMMUNITY COLLEGE DISTRICT

- d. Coordination drawings
 - e. Schedules (Critical path method, submitted to CONSTRUCTION MANAGER in accordance with the General Conditions)
 - f. Resolution of conflicts
3. Interpret Contract Documents:
- a. Consult with CONSTRUCTION MANAGER to obtain interpretation from the ARCHITECT.
 - b. Assist in resolution of questions or conflicts which may arise.
 - c. Transmit written interpretations to subcontractors and to other concerned parties.
4. Assist in obtaining permits and approvals:
- a. Building permits and special permits required for all Work or for temporary facilities.
 - b. Verify that subcontractors have obtained inspections for all Work through the D.S.A. approved INSPECTOR.
5. Control the use of site:
- a. Supervise field engineering and site layout.
 - b. Allocate space for each subcontractor's use for field offices, sheds, and work and storage areas as approved by the CONSTRUCTION MANAGER.
 - c. Establish access, traffic and parking allocations and regulations.
 - d. Monitor use of site during construction.

1.4 GENERAL DUTIES:

- A. Construction Schedules - Each Prime Contractor shall:

COMPTON COMMUNITY COLLEGE DISTRICT

1. Prepare a detailed schedule of basic operations for all subcontractors.
 - a. Each subcontractor shall prepare sub-schedules to comply with critical phases.
2. Monitor schedules as work progresses:
 - a. Identify potential variances between scheduled and probable completion dates for each phase.
 - b. Recommend to CONSTRUCTION MANAGER adjustments in schedule to meet required completion dates.
 - c. Adjust schedules of subcontractors as required.
 - d. Document changes in schedule, submit to DISTRICT and ARCHITECT/ENGINEER through the CONSTRUCTION MANAGER and to involved subcontractors.
 - e. Upon written notice by CONSTRUCTION MANAGER, PRIME CONTRACTOR shall, within three (3) calendar days, provide a complete recovery schedule, including manpower loading, resource loading, detailing how the PRIME CONTRACTOR and his subcontractors will recover PRIME CONTRACTOR'S original scheduled milestone dates. Recovery schedule shall show overtime, weekends, or multiple shifts as necessary to meet each milestone of the original schedule.
3. Observe Work of each subcontractor to monitor compliance with schedule.
 - a. Verify that labor and equipment are adequate for the Work and the schedule.
 - b. Confirm that product procurement schedules are adequate.
 - c. Confirm that product deliveries are adequate to maintain schedule.

COMPTON COMMUNITY COLLEGE DISTRICT

- d. Report noncompliance to District D.S.A. approved INSPECTOR, with recommendation for changes.
- B. Process Shop Drawings, product data and samples - Each Prime Contractor shall:
1. Prior to submittal to ARCHITECT/ENGINEER, review for compliance with Contract Documents:
 - a. Field dimensions and clearance dimensions.
 - b. Relation to available space.
 - c. Relation to other contracts and to other trades.
 - d. Effect of any changes on the Work of any other contracts or other trades.
 - e. Provide written approval that submittals have been approved by Prime Contractor.
- C. Review coordination drawings prepared by mechanical and electrical Contractors - Each Prime Contractor shall:
1. Prior to submittal to ARCHITECT/ENGINEER, through the CONSTRUCTION MANAGER, review for compliance with Contract Documents.
 2. Resolve conflicts and assure coordination of the Work of, or affected by, mechanical and electrical trades, or by special equipment requirements.
- D. Inspection and testing - Each Prime Contractor shall:
1. Inspect Work to assure performance in accordance with requirements of Contract Documents.
 2. Bring to ARCHITECT'S/ENGINEER'S attention, through the CONSTRUCTION MANAGER, the need of any special testing and inspections of suspect Work.
 3. Reject Work which does not comply with requirements of Contract Documents.
 4. Coordinate Testing Laboratory services:

COMPTON COMMUNITY COLLEGE DISTRICT

- a. Verify that required laboratory personnel are present.
 - b. Verify that tests are made in accordance with specified standards.
 - c. Review test reports for compliance with specified criteria.
 - d. Recommend and administer any required retesting.
- E. Monitor the use of temporary utilities - Each Prime Contractor shall verify that adequate services are provided and maintained.
- F. Monitor the PRIME CONTRACTOR'S periodic cleaning - Each Prime Contractor shall:
1. Enforce compliance with Specifications.
 2. Resolve any conflicts.
- G. Arrange for delivery of DISTRICT furnished products - Each Prime Contractor shall:
1. Inspect for condition at delivery.
 2. Turn over to appropriate subcontractor, obtain receipt.
- H. Changes and substitutions - Each Prime Contractor shall:
1. Recommend necessary or desirable changes to DISTRICT and to ARCHITECT/ENGINEER, through the CONSTRUCTION MANAGER.
 2. Review subcontractor's requests for changes and substitutions. Submit recommendations to DISTRICT and to ARCHITECT/ENGINEER through the CONSTRUCTION MANAGER.
 3. Assist ARCHITECT/ENGINEER, through the CONSTRUCTION MANAGER, in negotiating Change Orders.
 4. Promptly notify all subcontractors of pending changes or substitutions.

1.5 CLOSE-OUT DUTIES:

COMPTON COMMUNITY COLLEGE DISTRICT

- A. Mechanical and electrical equipment start-up:
1. Coordinate check-out of utilities, operations systems, and equipment.
 2. Assist in initial start-up and testing.
 3. Record dates of start of operation of systems and equipment.
 4. Submit to DISTRICT written notice of beginning of warranty period for equipment put into service.
- B. At completion of Work of each Prime Contract, conduct an inspection to assure that:
1. Specified cleaning has been accomplished.
 2. Temporary facilities have been removed from site.
- C. Substantial Completion:
1. Conduct an inspection to confirm or supplement Prime Contractor's list of work to be completed or corrected.
 2. Assist ARCHITECT/ENGINEER, through the CONSTRUCTION MANAGER, in preparation of correction list.
 3. Supervise correction and completion of Work as established in Certificate of Substantial Completion.
- D. When DISTRICT occupies a portion of Project prior to final completion, coordinate established responsibilities of PRIME CONTRACTOR and DISTRICT.
- E. Final Completion:
1. When each Prime Contractor determines that Work is finally complete, conduct an inspection to verify completion of Work, prior to Punchlist.

COMPTON COMMUNITY COLLEGE DISTRICT

2. Assist ARCHITECT/ENGINEER, through the CONSTRUCTION MANAGER, in verification of final completion.
- F. Administration of Contract Close-out: - Each Prime Contractor shall:
1. Review final submittals and as-builts prior to transmittal.
 2. Transmit to ARCHITECT/ENGINEER, through the CONSTRUCTION MANAGER, with recommendations for action.

1.6 REQUEST FOR INFORMATION

- A. Each Prime Contractor shall plan, schedule, coordinate and sequence Work so Requests for Information (RFI), if necessary, may be submitted to the Architect/Engineer in a timely manner so as not to delay progress of Work. Submission of and responses to RFI(s) with copies to Owner, shall be transmitted via facsimile (FAX) equipment or via email to designated email addresses.
- B. Telephone conversations requesting information shall be confirmed in writing for prompt reply of all RFI(s). Prime Contractor shall coordinate the timing of facsimile (FAX), email and telephone conversations to be made with the Architect's/Engineer's office between the hours of 8:00 a.m. and noon, Monday through Friday.
- C. Architect/Engineer shall have the same time period to respond to RFI(s) as "shop drawing review period". When Architect/Engineer responds to an RFI within 5 working days after receipt of RFI but when the response already is contained or included within contract documents, or is based on referenced standards, or is based on established and common construction practices, Contractor shall reimburse the Architect at the following hourly rates:

Principal	\$150
Associate Architect/Project Manager	100
Project Architect/Engineer	85
Job Captain	70
Draftsperson	65
Support Staff	45

If RFI requires Architect's/Engineer's Consultant(s) acknowledgement, Prime Contractor shall reimburse consultant(s), at the same hourly rate for consultant's staff; Prime Contractor shall also pay to the Architect, a percentage for overhead and profit to

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the consultant's fee, equal to the markup the Prime Contractor adds to "Change Orders".

- D. Prime Contractor shall be billed at "Request for Payment" meeting, and payment is due on the 10th day of the following month. If payment is not received by Architect/Engineer by that date, Architect's/Engineer's response to pending RFIs will be delayed by the same number of days as the days the payment check for RFI services is late.
- E. No damages for delay due to RFI response beyond allotted time will be allowed, unless Contractor can show that RFI was not foreseeable with proper planning, scheduling, coordination, and sequencing, and the Architect's/Engineer's late response delayed timely purchase or delivery of equipment or material, or limited construction personnel from proceeding with their task(s), within previously listed "Construction Schedule" activity period(s).

1.7 QUALITY ASSURANCE

- A. Familiarity with Contract Documents:
 - 1. Prime Contractor and all Subcontractors shall conduct a study necessary to become completely familiar with all requirements. Applicable requirements indicated or described in the Contract Documents, and the publications referred to, are a part of the Work required as though repeated in each such Section.
 - 2. In the event discrepancies or conflicts are encountered, notify the Architect/Engineer immediately. Where there is discrepancy between different parts of the contract documents, including referenced codes and standards, the documents requiring the higher quality, the greater quantity, or the more difficult work shall govern, unless determined otherwise by the Architect.
 - 3. Promptly distribute required information to entities concerned and ensure the needed actions are taken.
- B. Reporting: Unless otherwise noted by the Prime Contractor in his transmittals, all of the Prime Contractor's data transmittals to the Architect/Engineer for the Architect's/Engineer's review will be construed as stipulating that the Prime Contractor has thoroughly and completely reviewed and coordinated the data prior to transmittal.

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- C. Interfacing: It shall be solely the responsibility of each Prime Contractor to make sure that the assigned work completes in a timely manner and that all interfaces are prepared, connected, and function as required.

PART 2 – PRODUCTS – All products will be submitted and approved by the Architect/Engineer prior to purchase and then placement.

PART 3 - EXECUTION

3.1 PLANNING THE WORK

- A. By thorough advance planning of activities, coordinate the following in addition to other coordination activities required:
 - 1. Materials, services, and equipment purchasing.
 - 2. Shipping.
 - 3. Receipt and storage at the site.
 - 4. Installation, including interface with related items.
 - 5. Inspection and testing, to the extent required under the Contract.
 - 6. Assistance in initial start-up and operational tests.
 - 7. Completion of the Work, including removal and disposal of Contractor's surplus material and equipment, and final cleaning of structures and sites.

3.2 COORDINATION

- A. Coordinate construction activities included under various Sections of these Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation connection and operation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work.

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3.3 GENERAL INSTALLATION PROVISIONS

- A. Coordination methods used by the Prime Contractor are at the Prime Contractor's option, except that the Architect/Engineer may disapprove Work completed by the Prime Contractor or data submitted by the Prime Contractor when, in the Architect's/Engineer's judgment, coordination has been inadequate to ensure the specified quality.
- B. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

END OF SECTION

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ACCELERATION OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for the acceleration of the work by the Contractor.
 - 1. Where work is falling behind the construction schedule and the total project may not be completed by the date for contract completion as adjusted by change orders.
 - 2. Where the District requires the entire project or a portion thereof be completed at a date earlier than the contract completion date as adjusted by change orders.
- B. Related Sections
 - 1. Section 01 25 00 - Contract Modifications Procedures
 - 2. Section 01 29 00 - Payment Procedures
 - 3. Section 01 33 00 - Submittals.
- C. Construction Completion date as stated in the Agreement shall be the completion dated as revised by all time extensions granted at the time acceleration of the work begins.

1.2 NOTICE TO ACCELERATE WORK

- A. If in the judgment of the Architect and School District it becomes necessary at any time to accelerate the work or a portion thereof to increase rate of progress, Contractor when directed in writing, shall increase his construction forces, equipment, hours of work, number of shifts, delivery of materials and provide means to insure timely completion of the project.
 - 1. Any increase in cost to Contractor to accelerate the work progress to meet construction schedules or contract completion dates are the responsibility of the Contractor.
 - 2. Contractor shall not be entitled to additional compensation for additional effort he applies to the work to meet construction schedules or contract completion dates.

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3. Overtime hours by Contractor or its Subcontractors are the responsibility of the Contractor and are not grounds for additional compensation.
- B. If in the judgment of the Architect/Engineer and School District it become necessary at any time to accelerate the work or a portion thereof be completed at a date earlier than the contract completion date, Contractor when directed in writing, shall increase his construction forces, equipment, hours of work, number of shifts, delivery of materials and provide means to insure an earlier completion date.
1. Architect/Engineer and District shall determine new accelerated completion date.
 2. Any increase in the cost to Contractor in compliance with such accelerated completion date shall be adjusted by Change Order.
- C. All directives or orders to accelerate the work will be in writing. Any directive or order terminating acceleration of the work will be in writing.
- D. Phased Construction: Where the project includes phased construction and portions of the project are to be completed at earlier times than other portions of the contract, the above stated acceleration provisions shall apply to each phase of the construction contract.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Contractor shall when so directed by the Architect/Engineer or School District to accelerate the work or portion thereof, deploy Subcontractors, accelerate material deliveries, increase work forces, increase hours of work, provide additional shifts or provide other methods to accelerate progress of the work.
- B. Contractor shall within ten (10) calendar days after receiving written notice to accelerate the work, provide in writing to the Architect/Engineer and District specific measures being taken or planned to increase rate of progress along with a revised Construction Schedule. Architect/Engineer may require the Contractor to make adjustments in the plan of action to insure acceleration of the work.

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- C. Contractor shall continue acceleration of the work until scheduled progress is regained for timely completion of the project. Timely completion shall be understood as the contract completion date, as revised by all time extensions granted at the time acceleration begins.

1.4 REVISED CONSTRUCTION SCHEDULE

- A. Critical-Path Acceleration of Work Schedule: Prepare a new revised fully developed, Critical Path Method type Contractor's construction schedule showing an Acceleration of Work Schedule and new completion dates where an earlier completion date is directed. Revised schedule shall show acceleration of work scheduled to increase progress of the work to provide for timely completion of the project.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

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SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements for the submittal of Shop Drawings, product literature, samples, RFIs, and other data.
 - 1. To ensure that specified products are furnished and installed in accordance with the design intent, procedures have been established for advance submittal of relevant data, and for review and acceptance or rejection of that data by the Architect.
 - 2. Procedures have been established to ensure that Contractor requests for information and clarification are processed efficiently and promptly.
- B. Referenced Documents and Sections:
 - 1. Document 00 72 00 - General Conditions.
 - 2. Section 01 45 00 - Quality Control.
 - 3. Section 01 63 00 - Product Substitution Procedures.
- C. Substitutions: Requests for substitutions shall be made in accordance with the provisions of, and in a form described in, Section 01 63 00.

1.2 DEFINITIONS

- A. Request For Information (RFI): A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
 - 1. Proper RFI: An RFI that includes a detailed written statement indicating the specific Drawings or Specification section in need of clarification and the nature of the clarification requested.
- B. Improper RFIs: RFIs that are not properly prepared.

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1. Improperly prepared RFIs will be processed by the Architect/Engineer at the Architect's/Engineer's standard hourly rate. The Architect will charge the Owner, and such costs will be deducted from monies still due the Contractor.
 - a. The Contractor will be notified by the Architect/Engineer prior to the processing of Improper RFIs.
- C. Frivolous RFIs: RFIs that request information that is clearly shown on the Contract Documents.
 1. Frivolous RFIs may be returned unprocessed. If processed, the Architect may charge the Owner at the Architect's/Engineer's standard hourly rate, and such costs will be deducted from monies due the Contractor.
 - a. The Contractor will be notified by the Architect/Engineer prior to the processing of Frivolous RFIs.

1.3 SCHEDULE OF SUBMITTALS

- A. Schedules: Furnish required schedules in accordance with the General Conditions listing all items that will be submitted for acceptance-review by the Construction Manager and Architect/Engineer.
 1. Include Shop Drawings, manufacturer's literature, test procedures, test results, certificates of compliance, material samples, and special guaranties.
 2. Indicate scheduled dates for submitting the above items, projected needs for responses, and procurement dates.
 3. Revise and update submittal schedule as required to keep current. Make revised schedules available to the Architect/Engineer for review.
- B. For drawings larger than 11 inches by 17 inches, submit two copies of blueline prints, and one reproducible sepia or vellum of each Shop Drawing submittal, or as determined by mutual agreement. One reproducible copy will be returned to Contractor for reproduction and distribution as required.

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1. Alternately, provide two sets of plain bond paper copies 11 inches by 17 inches in size.
- C. Make submittals in accordance with the General Conditions to allow adequate time for securing necessary acceptances, for revision and resubmittal, for placing orders and securing delivery, and to accommodate the rate of construction progress required under the Contract.
- D. Do not begin work requiring submittals until the submittals have been returned with the other professional consultant's stamp indicating review and acceptance.
1. Provide acknowledgement stamp by Contractor signifying review and acceptance of submittal as defined in Article 1.5 - Coordination of Submittals.
- E. Submittals with Bid:
1. Elevators: Provide copies of Preventive Maintenance Contract in accordance with Project Manual Elevator Specifications (if any).

1.4 IDENTIFICATION OF SUBMITTALS

- A. On submittal forms acceptable to the Architect/Engineer, identify each submittal and resubmittal by including the following information:
1. Name and address of submitter, including name and telephone number of the individual to be contacted for further information.
 2. Complete name of Project.
 3. Drawing number and Specification Section number to which the submittal applies.
 4. Whether submittal is an original or a resubmittal.
 5. Date submittal was prepared or revised.

1.5 COORDINATION OF SUBMITTALS

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- A. General: Fully coordinate materials prior to submittal for review. Include a transmittal form with a signed statement that submittal satisfies the following procedures:
 - 1. Determine and verify field dimensions and other field conditions.
 - 2. Coordinate with work of related trades.
 - 3. Coordinate with the requirements of public agencies having jurisdiction.
 - 4. Secure required approvals from public agencies and signify by stamp, or other legitimate means, that they have been secured.
 - 5. Indicate necessary deviations from the Contract Documents in a clear manner.
- B. Grouping of Submittals: Make submittals in groups containing associated items. The Architect reserves the right to reject partial submittals as not complying with provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT DATA

- A. When required by Part 1 - General of the respective Sections, submit manufacturer's printed product data and instructions for products used on the Project. Include catalog cuts, diagrams, and other descriptive material published by the manufacturer, as well as evidence of compliance with safety and performance standards to demonstrate conformance to the specified requirements. Catalog numbers alone will not be acceptable.
 - 1. Include complete lists of materials, illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information proposed for use, giving manufacturer's name, catalog number, and catalog cut for each item, where applicable.
 - 2. When materials, equipment, or fixtures are identified by numeric, alphabetical, or alphanumerical designations,

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identify materials, equipment, and fixtures proposed for use with identical designations.

2.2 SHOP DRAWINGS

- A. When required by Part 1 - General of the respective Sections for the various portions of the construction, provide special detailed drawings, diagrams, schedules, and other data in amplification of the Contract Documents before proceeding with the work.
 - 1. Refer to Document 00 72 00 - General Conditions for obligations under the Contract regarding Shop Drawings, product data, and samples.
- B. Submit Shop Drawings prepared by qualified detailers. Identify details by reference to Contract Drawing sheet and detail numbers and by specification section and article numbers. Provide a blank area approximately 4 inches by 4 inches for Architect's review stamp.
 - 1. Do not use reproductions of Contract Drawings for fabrication or erection drawings.
- C. Shop Drawings submitted shall include not less than the following:
 - 1. Dimensioned plans, elevations, and sections locating assembly components in relationship to each other and in relationship to contiguous building structure.
 - 2. Typical and special fabrication and installation details, including details of anchorage to supporting structure.
 - 3. Materials and finishes.
- D. Indicate desired deviations from Contract Drawings on Shop Drawings by placing a heavy line around features on which acceptance is requested. Append a note to each deviation specifically requesting acceptance.
 - 1. Contractor is advised that the identification of "desired deviations" will not be construed as a means of requesting substitutions. Make requests for substitutions in accordance with the provisions of Section 01 63 00.
- E. Refer to Part 3 - Execution, for additional review documentation procedures.

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2.3 SAMPLES

- A. When required by Part 1 - General of the respective Sections of the Specifications, submit physical examples of each item which illustrate materials, equipment, or workmanship, and establish standards by which the work will be judged.
- B. All products requiring color selection shall be submitted prior to any selection of colors by the Architect/Engineer. Allow sufficient time for color selection of all items so as not to delay construction progress.

2.4 QUALITY CONTROL SUBMITTALS

- A. Test Reports: When and as directed by the Architect/Engineer, submit certified laboratory test reports confirming physical characteristics of materials used in the performance of the work. Refer to Section 01 45 00 for general requirements for inspections and tests.
- B. Manufacturer's Instructions: Submit manufacturer's current recommended methods of installation, including relevant limitations, safety and environmental cautions, and application rates.

2.5 EQUIPMENT ROOM LAYOUT DRAWINGS

- A. Prepare and submit equipment room layout drawings where required by the Contract Drawings and additionally for areas where equipment proposed for use could present interface or space difficulties.
 - 1. Submit room layout drawings within 10 calendar days after receipt of Notice to Proceed in conformance with the requirements specified for Shop Drawings.
 - 2. Include elevations of wall mounted items.

2.6 CERTIFICATES OF COMPLIANCE

- A. When required by Part 1 - General of the respective Sections of the Specifications, furnish certificates to demonstrate compliance of materials with specification requirements, including statements of application and extended guaranties, executed in duplicate. Furnish certificates to the Architect at least 10 days prior to delivery of product. Review certificates before submittals are made to ensure

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compliance with the specification requirements, and to ensure that the affidavit is properly executed.

1. Furnish certificates relative to flame-resistance for all decorative materials.
- B. Furnish certificates signed by an official authorized to act on behalf of the manufacturing company, material supplier, or other third-party entity, as required. Furnish certificates that contain the name and address of the Contractor, the Project name and location, and the quantity and dates of shipment or delivery to which the certificates apply. In the case of copies of laboratory test reports submitted with certificates, furnish test reports which contain the name and address of the testing laboratory and the dates of the tests to which the report applies.
- C. Certification will not be construed as relieving the Contractor from furnishing satisfactory material if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

2.7 CONSTRUCTION COST BREAKDOWN

- A. Within 10 calendar days after issuance of Notice to Proceed, submit a Construction Cost Breakdown (Schedule of Values) based on final Contract Sum and scope of work for use in evaluating construction progress and certificates of payment.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Check subcontractor-submitted drawings and data, verify field measurements, apply review stamp, and submit to the Architect/Engineer promptly.
1. Indicate on review stamp that Contractor has reviewed subcontractor's submittal for conformance to the specified product and submittal procedures.
 2. Disapprove and return to the material supplier, submittals not meeting the requirements of the Contract Documents.

3.2 ARCHITECT'S REVIEW

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- A. The Architect/Engineer will review, and either accept or reject with reasonable promptness and as outlined in the accepted submittal schedule, data and drawings submitted by the Contractor. The Architect/Engineer will review submittals for conformance with the intent of the design, and for compliance with specific and relevant requirements of the Contract Documents.
1. The Architect/Engineer will reject and return to the Contractor, Shop Drawings and product literature submitted without the Contractor's review stamp.
 2. The Architect/Engineer will reject and return to the Contractor, Shop Drawings not thoroughly reviewed by Contractor prior to submittal.
- B. The Architect/Engineer is not responsible for delays caused by rejection of Shop Drawings submitted by the Contractor.
- C. Review Procedures:
1. Review will not relieve the Contractor from responsibility for errors.
 - a. Acceptance of submittals shall not be construed as authorizing changes in the Contract Sum or Contract Time, nor shall it be construed as relieving the Contractor of his responsibility for coordination of work with other trades, or interpreted as approving quantities and dimensions.
 2. Notations:
 - a. REVIEWED: Fabrication, manufacture, or construction may proceed.
 - b. MAKE CORRECTIONS NOTED: Fabrication, manufacture, or construction may proceed providing submittal complies with comments and notations. If, for any reason, Contractor cannot comply with the comments and notations, Contractor shall bring reasons to the attention of the Architect/Engineer promptly. If Contractor cannot comply with the comments and notations, the MAKE CORRECTIONS NOTED becomes REJECTED. The Contractor shall return the revised version of the submittal to the Architect/Engineer when requested to do so.

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- c. REJECTED: Submittal does not comply with the Contract Documents and fabrication, manufacture, and construction shall not proceed. Submittals stamped REJECTED are not permitted on the job site. Review and re-submit submittal.

3.3 DISTRIBUTION OF SUBMITTALS BY CONTRACTOR

- A. After Architect's/Engineer's review, distribute copies of Shop Drawings and product data which carry the Architect's/Engineer's stamp as determined at the pre-construction meeting. If not otherwise determined, distribute one copy to each of the following:
 - 1. Contractor's Project site file.
 - 2. Project record documents file.
 - 3. Subcontractor, supplier, or fabricator.
 - 4. Other prime Contractors, if applicable.
 - 5. Owner's Representative (at Owner's option).
- B. Distribute samples as directed.
- C. Maintain an up-to-date submittal log.

3.4 CONTRACTOR'S RESPONSIBILITY

- A. The Architect's/Engineer's review of submittals or data shall not relieve the Contractor from responsibility for deviations from Contract Drawings or Specifications unless the Contractor has called the Architect's/Engineer's and Owner's attention to such deviations and secured written acceptance, nor shall it relieve him of responsibility for errors in Shop Drawings or other data.
- B. In the event the Architect/Engineer rejects a submittal twice for valid reasons, including improper procedures, the Contractor shall accept the responsibility to pay for professional services to cover further processing of the submittal. A flat hourly rate, as agreed upon, shall be paid by the Contractor.

END OF SECTION

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REFERENCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for reference materials applicable to contract documents
- B. Definitions of abbreviations, terms, and symbols.
- C. Establishes edition dates for reference standards found elsewhere in the specifications.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions.
- B. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended. Except as specifically noted.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Architect/Engineer," "requested by the Architect/Engineer," and similar phrases. However, no such implied meaning will be interpreted to extend Architect/Engineer responsibility into Contractor's area of construction supervision.
- D. Approve: The term "approved," where used in conjunction with the Architect's/Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Architect's/Engineer's duties and responsibilities as stated in General and Supplementary Conditions. In no case will "approval" by the Architect/Engineer be interpreted as a release of the contractor from responsibilities to fulfill requirements of contract documents.
- E. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction,

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as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

- F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
- G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
- H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
- I. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term "experienced" when used with the term "Installer" means having a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the precautions required, and having complied with requirements of the authority having jurisdiction.
- J. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
- K. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 REFERENCE STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or

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copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of bid date or date of Contract Execution, for projects that are not competitively bid.

- C. Upon request, the Contractor is required to make available at the job site within a reasonable time a copy of all referenced standards referred to in the Specifications. Standards are to be maintained in the Project Job Site Office Library for use by the Architect/Engineer, School District and School District's inspector for the purpose of establishing requirements applicable to equipment, materials, quality and workmanship.

- D. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.

1.4 ABBREVIATIONS

- A. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

- B. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries or the Construction

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Specifications Institute (CSI) Technical Document TD-2-5
November 1989, entitled "Sources of Construction Information".

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION



COMPTON COMMUNITY COLLEGE DISTRICT
1111 E. Artesia Blvd
Compton, California 90221
(310) 900-1600

**RFQ CCC-XXX
Student Services Building**

Work Plan and Milestone Schedule

Task Name

Finish Date

Pre-bid Mandatory Job Walk:
Bid Opening:
Notice of Intent to Award:
Start Construction Phase:
Construction Completion:
Punchlist/Closeout completion:

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QUALITY CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies administrative and procedural requirements for quality control services.
- B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect/Engineer.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
 - 2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for the Contractor to provide quality control services required by the Architect/Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Inspections and testing required by laws, ordinances, rules, regulations or orders of public authorities: General Conditions.

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- B. Certification of Products: Respective specification sections.
- C. Test, Adjust and Balance of Equipment: Respective specification sections.

1.3 RESPONSIBILITIES

- A. The Owner will engage and pay for the services of an independent agency to perform inspections and tests specified as the Owner's responsibilities. Testing agency and project inspector shall have approval of the Division of the State Architect.

1.4 DEFICIENCIES

- A. Tests or inspections due to the following will be reimbursed to the Owner by deductive change order.
 - 1. Retesting because of failure of initial samples.
 - 2. Additional costs due to overtime work or extra shifts work because of improper scheduling of work or of delivery of materials by Contractor.
 - 3. Failure to properly notify laboratory.
 - 4. Changes in sources, lots or suppliers of materials after original tests.
 - 5. Changes in methods or materials of construction requested by Contractor that require testing, inspection, or other related services in excess of that required by original design.
 - 6. Concrete mix designs in excess of first successful design for each concrete type.
 - 7. Overtime or extra shift work requiring overtime work by Owner's Inspector.
 - 8. This contractor will have the sole responsibility of coordinating the Schedule with the Construction Manager for Owner/General Contractor, Bid Package 01, provided Fire Watch.

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1.5 TESTS

- A. Selection of the material required to be tested shall be the responsibility of the laboratory or the Owner's representative and not selected by the Contractor.
- B. The Contractor shall notify the Owner's representative a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must be tested, in order that the Owner may arrange for the testing of material at the source of supply.
- C. Any material shipped by the Contractor from the source of supply prior to satisfactory testing and inspection or prior to the receipt of notice from said representative that testing and inspection will not be required shall not be incorporated in the work.
- D. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect/Engineer and Contractor in performance of its duties, and is to provide qualified personnel to perform required inspections and tests.
 - 1. Notify the Architect/Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
 - 3. The agency shall not perform any duties of the Contractor.
- E. Perform specified instructions, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards; ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of Contract Documents.
 - 3. Comply with requirements of Title 24, Part I, Sec. 4-333.

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- F. Coordination: The Contractor and each agency engaged to perform inspections, tests, Fire Watch and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1.6 SUBMITTALS

- A. Promptly submit copies of reports of inspections and tests mill analysis, concrete mix designs and certifications per applicable sections of the specifications.
1. Comply with requirements of Division of State Architect testing and inspection requirements.
 2. One copy of all test reports shall be forwarded to the Division of the State Architect by the testing agency. Such reports shall include all tests made, regardless of whether such tests indicated that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. The reports shall show that the material or materials were sampled and tested in accordance with the requirements of Title 24, CCR and with the approved specifications. Test reports shall show the specified design strength. They shall also state definitely whether or not the material or materials tested comply with requirements.
 3. Verification of Test Reports: Each testing agency shall submit to the Office of the State Architect a verified report in duplicate covering all of the tests which are required to be made by the agency during the progress of the project. 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, covering all tests.
 4. Submit one copy of all test reports to:
 - a. Owner
 - b. Architect/Engineer
 - c. Structural Engineer
 - d. Contractor

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- e. Inspector
- f. Division of the State Architect (DSA)
- g. Submit verification of test reports to DSA per Title 24, Part 1, CCR, Sec. 4-336.

1.7 QUALITY ASSURANCE

- A. All tests and inspection required by the Division of the State Architect are to be conducted in strict accordance with requirements of Title 24, CCR.
- B. Contractor shall comply with all Project Inspection Card requirements (DSA Form 152), DSA PR 13-01 and 13-02, and all related DSA required inspection and testing requirements.

1.8 INSPECTION BY THE SCHOOL DISTRICT

- A. The School District and its representative shall at all times have access for the purpose of inspection to all parts of the work and to the shops wherein the work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- B. The School District shall have the right to reject materials and workmanship which are defective, or to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the School District. If the Contractor does not correct such rejected work within a reasonable time, fixed by written notice, the School District may correct same and charge the expense to the Contractor.
- C. Should it be considered necessary or advisable by the School District at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out the same, the Contractor shall on request promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any respect due to fault of the Contractor or his subcontractor, he shall defray all expenses of such examinations and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the additional cost of labor and materials necessarily involved in the examination and replacement shall be allowed the Contractor.

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- D. District to provide an Inspector employed by the District in accordance with the requirements of the California Code of Regulations, Title 24, to be assigned to the work. His duties are specifically defined in Title 24, Part I, Sec. 4-342. The work of construction in all stages of progress shall be subject to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the work at any time. The contractor shall furnish the Inspector reasonable facilities for obtaining 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. Inspection of the work shall not relieve Contractor from any obligation to fulfill this Contract.

1.9 WORK BY DISTRICT'S INSPECTORS

- A. General inspection of construction.
- B. Concrete slump tests.
- C. Concrete cylinder samples.
- D. Cement samples and tests.
- E. Reinforcing Steel sample and test, (#5 and larger).
- F. Continuous inspection of Structural Concrete placement.
- G. Structural Steel sample and test.
- H. Continuous inspection of welds, (shop and field).

1.10 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to work, to manufacturer's operations.
- B. Provide to laboratory, selected preliminary representative samples of materials to be tested, in required quantities.
- C. Furnish casual labor and facilities:
 - 1. To provide access to work to be tested.
 - 2. To obtain and handle samples at the site.

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3. To facilitate inspections and tests.
 4. For laboratory's exclusive use for storage and curing of test samples.
- D. Notify laboratory sufficiently in advance of operations to allow for his assignment of personnel and scheduling of tests. Per Specification Section 1305, the contractor will provide an updated 2 Week Look Ahead to ensure proper and timely scheduling.

PART 2 - PRODUCTS - (Not Applicable)

PART 3 - EXECUTION

3.1 MISCELLANEOUS TESTS AND INSPECTIONS

- A. Soil and Compaction Testing and Inspection: Performed by soils engineer employed and paid by the School District.
- B. Roofing Inspection: As specified in Section "Roofing".
- C. Moisture and Bond Tests for resilient flooring and non-breathing floor surface materials. Performed by Independent Testing Agency and paid for by the School District.
- D. Special Tests: Special tests requested by School District, Architect or Division of the State Architect will be paid for by the School District, except that if such tests fail, the costs for failed tests and additional retesting shall be deducted from the Contract Price by Change Order.

3.02 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

- A. 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.
- B. Tests and inspections for the following will be required in accordance with DSA IR 17-6 and the current CBC, unless otherwise specified.

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

- A. Structural Steel: Comply with quality assurance inspection requirements of ICC (IBC).
- B. Cold-Formed Steel Deck: Comply with quality assurance inspection requirements of SDI (QA/QC).
- C. 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.
- D. 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 shall be in accordance with AISC Specification for Structural Joints Using High Strength Bolts, 2009.
 - 2. Comply with DSA Interpretations:
 - a. IR 17-8.16: Sampling and Testing of High Strength Bolts, Nuts, and Washers 2016 and 2013 CBC; Revised 7/14/17.
 - b. IR 17-9: High-Strength Structural Bolting Inspection: 2016, 2013, 2010 and 2007 CBC; Revised 5/8/18.
- E. Welding:
 - 1. Testing Laboratory will review welding procedure specifications as prepared by the fabricator.
 - 2. Structural Steel:
 - a. Inspect welding per CBC 1705A.2.1.
 - 1) Comply with DSA IR 17-3: Structural Welding Inspection: 2016, 2013, 2010, and 2007 CBC; Revised 5/8/18.
 - 2) Provide tests of end welded studs per CBC 1705A.2.1.
 - 3) Inspect Nelson Stud Welding per CBC 1705A2.1.
 - 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 (7.94 mm) Wide: Verify compliance with AWS D1.1/D1.1M and AWS D1.8/D1.8M; 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 (7.94 mm) or Greater: Verify compliance with AWS D1.1/D1.1M and AWS D1.8/D1.8M; continuous.
 - g. Floor Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.

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3. Reinforcing Steel: Verify items listed below comply with AWS D1.4/D1.4M and ACI 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 multi-pass groove welds 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, repairs shall be similarly inspected 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.
 8. Perform all additional testing in AISC 341 Chapter J6.2.
- F. Steel Frame Joint Details: Verify compliance with approved Contract Documents.
1. Details, bracing and stiffening; periodic.
 2. Member locations; periodic.
 3. Application of joint details at each connection; periodic.
 4. Comply with approved DSA Form 103 Structural Tests and inspections.
- G. Corrections:

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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 Owner and backcharged to the Contractor.

3.04 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 1705A.3.3.

B. Reinforcing Steel, Including: Verify compliance with approved contract documents and ACI 318, Sections 20.2, 25.2 through 256.6, and 26.6.

1. Reinforcing Bars: CBC 1901A.6; 1910A.
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 Owner 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. Owner'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 318, 26.6.4; continuous.

1. Reinforcing Bar Welding Inspection: CBC 1705A.3.1; Table 1705A.3, Item 2; 1903A.8.

D. Anchors Cast in Concrete: Verify compliance with ACI 318, 17.8.2; periodic.

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- 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, and DSA Bulletin 14-02, 2/20/14.
- F. Anchors Post-Installed in Hardened Concrete: Verify compliance with ACI 318.
 - 1. Adhesive Anchors: Verify horizontally or upwardly-inclined orientation installations resisting sustained tension loads - Section 17.8.2.4; continuous.
 - 2. Other Mechanical and Adhesive Anchors: Verify as per Chapter 17.8.2; periodic.
- G. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with ACI 318, Chapter 19A, 26.4.3, 26.4.4; periodic.
 - 1. Portland Cement Tests: CBC 1705A.3.2, 1910A.
 - 2. Concrete Aggregates: CBC 1705A.3.2, 1903A.5.
 - 3. Batch Plant Inspection: CBC 1705A.3.2.
 - 4. Waiver of Batch Plant Inspection and Tests: CBC 1705A.3.3.
 - 5. Admixtures: CBC 1910A.1.
 - 6. Proportions of Concrete: CBC 1904A (Durability) and 1905A (Modifications to ACI 318).
- H. 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 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.1.16; Table 1705A.3 Item 6; ACI 318-14 Sec. 26.13..
- I. Concrete Placement: Verify application techniques comply with approved Contract Documents and ACI 318, Chapter 26.5; continuous.
- J. Specified Curing Temperature and Techniques: Verify compliance with ACI 318, Chapter 26.5.3-26.5.5; continuous.
- K. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents, CBC Table 1705A.3, and modified ACI 318, Chapter 26.12.2,1(a).
- L. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI 318, Chapter 26.11.1.2(b); continuous.

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- 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. Owner 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 Batch Plant Inspection above.
 6. During progress of work, take an additional number of test cylinders as directed by Architect. Conform to CBC 1905A.1.16 (modified ACI 318). Test cylinders need not be made for concrete used in exterior flatwork.
 - a. ACI 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.

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

- A. Masonry Structures Subject to Special Inspection:
1. 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:
 - a. Masonry Units CBC 2103A.1

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- b. Portland Cement, Lime CBC 2103A.3
- c. Mortar and Grout Aggregates CBC 2103A.2; 2103A.3
- d. Reinforcing Bars CBC 2103A.4
- 2. Masonry Quality:
 - a. Portland Cement Tests CBC 1903A, 1910A.1
 - b. Mortar and Grout Tests CBC 2105A.3
 - c. Masonry Core Tests CBC 2105A.4
 - d. Masonry Unit Tests CBC 2105A.2, 2105A.3, 1705A.4
 - e. Reinforcing Bar Tests CBC 1910A.2
- 3. Masonry Inspection:
 - a. Reinforced Masonry CBC 1705A.4
 - b. Reinforcing Bar Welding Inspection CBC 1705A.3.1;
Table 1705A.3, Item 2;
Table 1705A.3, Item 2; 1903A.8.
 - c. Post Installed Anchors in Masonry CBC 1616A.1.19; 1705A.4,
- 4. Veneer (Chapter 14):
 - a. Materials:
 - 1) Masonry Units CBC 2101A.2.6, 2103A.2.4
 - 2) Mortar CBC 2103.2
 - 3) Grout CBC 2103.3
 - b. Veneer Quality:
 - 1) Adhered Veneer - Bond Strength & Tests CBC 1405.10
 - c. Anchorage above exits or more than 20 feet above adjacent ground;
CBC 1411.2.
- 5. 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.
- 6. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.
- 7. Slump Flow and Visual Stability Index (VSI): Verify compliance as self consolidating grout arrives on site; continuous.
- 8. 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.
- 9. Structural Elements, Joints, Anchors, Protection: During masonry construction, verify:

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- 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 (50 degrees C) and cold weather below 40 degrees F (22 degrees C); periodic.
10. Grouting Preparation: Prior to grouting, verify:
- a. Grout space is clean; periodic.
 - b. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; periodic.
 - c. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
 - d. Correctly constructed mortar joints; periodic.
11. Preparation of Grout Specimens, Mortar Specimens and Prisms: Observe preparation of specimens; periodic.

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 Owner 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.

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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 FIRE RESISTANT PENETRATIONS AND JOINTS

- A. Verify penetration firestops in accordance with ASTM E2174.
- B. Verify fire resistant joints in accordance with ASTM E2393.
- C. Inspection: Comply with CBC 1705A.17.

3.08 SPECIAL INSPECTIONS FOR FIRE DOOR ASSEMBLIES

- A. Per NFPA 80 5.2.1:
 1. Provide a third party inspector not associated with the construction, supply or installation of this project to develop a field survey of the doors and hardware.
 2. Survey is to be done by a member certified as a FDAI (Fire Door Assembly Inspector), Certified AHC (Architectural Hardware Consultant) or a certified testing laboratory: UL or Intertek.
 3. Certified Inspectors may be found at DHI.org, Intertek, or CAFDI.org.

3.09 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

- A. Seismic Force-Resisting Systems: Comply with the quality assurance plan requirements of AISC 341.

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- B. Inspection: Comply with CBC 1705A.12.
- C. Testing: Comply with CBC 1705A.13.
- D. Seismic Evaluation: Comply with ASCE 41-13.
- E. Structural Steel: Comply with the quality assurance plan requirements of AISC 341.
- F. Cold Formed Steel Light Frame Construction:
 - 1. Field welding; periodic.
 - 2. Screw attachment, bolting, anchoring and other fastening of components within the main seismic force-resisting system; periodic.
- G. 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.12.5 and 1705A.13.2.
- H. 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 (6.35 mm) 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 (76 mm) 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.
- I. Cold-Formed Steel Special Bolted Moment Frames:
 - 1. Installation in seismic force-resisting systems; periodic.
- J. Designated Seismic System Verification: Verify label, anchorage or mounting complies with certificate of compliance provided by manufacturer or fabricator.
- K. Structural Testing for Seismic Resistance:

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1. Concrete reinforcement: Comply with ACI 318, Section 20.2.2.5 and 21.1.5.2.
 - a. Materials Obtain mill certificates demonstrating compliance with ASTM A615/A615M, or ASTM A706/A706M, grade when applicable; periodic.
 - b. Welding: Perform chemical tests complying with ACI 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.
- L. Structural Observations for Seismic Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

3.10 SPECIAL INSPECTIONS FOR WIND RESISTANCE

- A. Cold-Formed Steel Light Frame Construction:
 1. Field welding; periodic.
 2. Screw attachment, 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.

3.11 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.

3.12 SPECIAL ARCHITECTURAL INSPECTIONS

- A. Signs and/or identification devices:

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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 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) Tactile special egress control device signs per CBC 1010.1.9.7 Delayed Egress Locks, item 5.1.
 - 5) Elevator car control identification per CBC 11B-407.4.6-8 Elevator car controls.
 - 6) Sanitary facilities signage per CBC 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.

3.13 OTHER SPECIAL INSPECTIONS

- A. Provide for special inspection of work that, in the opinion of the AHJ, is unusual in nature.
- B. For the purposes of this section, work unusual in nature includes, but is not limited to:
 1. Construction materials and systems that are alternatives to materials and systems prescribed by the building code.
 2. Materials and systems required to be installed in accordance with the manufacturer's instructions when said instructions prescribe requirements not included in the building code or in standards referenced by the building code.
- C. Alternative Test Procedures: Where approved rules and standards do not exist, test materials and assemblies as required by AHJ or provide AHJ with documentation of quality and manner in which those materials and assemblies are used.

3.14 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

- A. Special Inspection Agency shall:

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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. 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 paid for by Contractor.

3.15 TESTING AGENCY DUTIES AND RESPONSIBILITIES

- A. Testing Agency Duties:
1. Test samples 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. Attend preconstruction meetings and progress meetings.
 8. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:

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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 Owner'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.
- 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.

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- 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.

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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

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- 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.

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- 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

3.16 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. DSA Requirements:

1. Each Multi-Prime Contractor or Subcontractor shall comply with DSA Construction Oversight Procedure 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.

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- (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.

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- 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. Contractor shall make materials required for testing available to Laboratory and assist in acquiring these materials as directed by the Owner's Inspector. The samples shall be taken under the immediate direction and supervision of the Testing Laboratory or Owner'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 Owner. 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 Owner and backcharged to the Contractor.
 - d. Contractor shall give sufficient advance notice to Testing Laboratory in the event of cancellation or time extension of a scheduled test or inspection. Charges due to insufficient advance, notice of cancellations, or time extension will be paid for by the Owner and backcharged to the Contractor.
 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.

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5. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 7. The Contractor shall notify the Owner'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 Owner 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 Owner 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 Owner 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

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listed in the Statement of Special Inspections to AHJ and Owner 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.

3.17 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 Owner.
- 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

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TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.
- B. Temporary utilities required include but are not limited to:
 - 1. Water service and distribution.
 - 2. Temporary electric power and light.
 - 3. Telephone service with separate Fax line.
 - 4. Storm and sanitary sewer.
- C. Temporary construction and support facilities required include but are not limited to:
 - 1. Temporary heat.
 - 2. Field offices and storage sheds.
 - 3. Sanitary facilities, including drinking water.
 - 4. Temporary enclosures.
 - 5. Temporary Project identification sign.
 - 6. Waste disposal services.
- D. Security and protection facilities required include but are not limited to:
 - 1. Temporary fire protection. Coordination of Fire Watch.
 - 2. Barricades, warning signs.
 - 3. Environmental protection.

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4. Temporary security fencing when required and in compliance with the Phase temporary fencing provided by Bid Package xx.

1.2 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

1.3 RELATED WORK

- A. All equipment furnished by subcontractors shall comply with all requirements of pertinent safety regulations. The ladders, planks, hoists, and similar items normally furnished by the individual trades in execution of their own portions of the work are not part of this section.
- B. Permanent installation and hook-up of the various lines are described in the other pertinent sections.

1.4 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
 1. Building Code requirements.
 2. Health and safety regulations.
 3. Utility company regulations.
 4. Police, Fire Department and Rescue Squad rules.
 5. Environmental protection regulations.
- B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design Library "Temporary Electrical Facilities."
 1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.

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2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials; if acceptable to the Architect/Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- B. Water: Provide potable water approved by local health authorities.

2.2 FIELD OFFICE

- A. Provided by this Bid Package; Provide on-site, adequate field space for use by construction forces, the District Inspector, and the Architect during the time construction is in progress. The offices shall be conveniently located and shall be watertight and waterproof, clean, insulated, heated, cooled, lockable, provided with windows to give adequate light and ventilation, have electrical service outlets, and have a floor. Minimum size of temporary site construction is 360 square feet.
 1. The Contractor shall provide and pay for separate telephone service for phone and fax machine. Telephone and fax machines are to be on separate telephone line.

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2. Equip with a minimum of one desk and a layout table. Equip with additional folding chairs for field meetings.
 3. The offices, equipment, and furniture shall remain the property of the Contractor and shall be removed by contractor upon completion of work.
 4. A complete set of approved plans and specifications shall be kept in the office at all times.
- B. Inspectors Field Office: Contractor is required to provide for the use of the School District's Inspector a temporary office space to be located as directed by the Inspector and to be maintained until removal is authorized by the School District. Space is to have a lockable separate room area with a table for plans and a desk with two chairs. At least one entrance to Inspector office space is to be from the outside and not through the Contractors field office space. Provide and pay for high speed internet service. Maintain for Inspector until completion of the Contract.

2.3 TOILET FACILITIES

- A. Provided by Each Bid Package for their personnel; Provide, install and maintain, for during of the work, temporary outside toilet facilities for use of construction personnel. Toilet facilities shall be constructed, maintained and supplied as required for the numbers of construction personnel required, and according to local regulations.

2.4 FIRST AID

- A. Maintain such first aid supplies as may be required for minor accidents. Make arrangements with local emergency center and nearest hospital to receive cases requiring medical attention, including emergencies. Such information shall be conspicuously displayed at the construction office.

2.5 WATCHMAN SERVICES

- A. Provided by this Bid Package; The Contractor shall provide such watchman services as he may deem necessary to properly safeguard materials, tools, appliances, and work during all hours that operations under the Contract are not actively proceeding. The District will not assume any responsibility for the loss of or damage to materials, tools, appliances or work arising from acts of theft, vandalism, malicious mischief, or other causes.

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2.6 FIRE PROTECTION

- A. Provide fire extinguisher on the premises during the course of construction of the type and sizes recommended by the NBFU to control fires resulting from the particular work being performed. Instruct employees in their use. Place extinguisher in the immediate vicinity of the work being performed, ready to be used.
- B. During the use of hazardous equipment such as acetylene torches, welding equipment, bitumen kettles, salamanders and similar devices, no work shall be commenced or equipment used unless fire extinguisher of an approved type and capacity are placed in the working area and available for use by the workmen using such hazardous equipment.
- C. Provide fire extinguisher conforming to the requirements, as minimums, of NFPA 10 and 241.

2.7 SAFETY AND PROTECTION

- A. Provided by this Bid Package the Contractor shall furnish and erect temporary or permanent fences around the areas, as indicated on the drawings, and elsewhere where required for protection of the work, and to prevent unauthorized persons from entering the construction area. Temporary fences shall be at least eight feet (6'-0") above grade, of chain link or other substantial construction. Necessary gates for access to the site shall be placed where directed by the School District.
- B. Furnish or construct barricades, lights and other guards about the work area that may be required by local ordinance or for public safety and necessity. Protect all work from vandalism.

2.8 TEMPORARY UTILITY SERVICES

- A. Provided by this Bid Package; Power and Lighting: Furnish, install and maintain temporary wiring, poles, meter board, service entrance switch, lamps and equipment necessary to provide temporary lighting and power for the construction site.
 - 1. Temporary power is available from location as directed by the Power Company.
 - 2. Any temporary transmission lines required shall be installed by Contractor.

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3. Provide power sources within eighty feet of any working position to allow the use of one hundred foot extension cords.
- B. Water: Install required temporary connections to existing water. Locate temporary pipelines so that they do not interfere with traffic or drainage. Design and construct such pipelines so that they do not leak or cause damage or nuisance.
1. Upon completion of work, remove all temporary piping.

2.9 HEAT AND VENTILATION

- A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate the progress of the work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature and humidity.
1. Pay costs of installation, maintenance, operation and removal, and fuel consumed.

2.10 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required by personnel and to facilitate the execution of the work; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.
- B. Provide all necessary facilities and means of access to all parts of the structure so that Governmental Agency Inspectors, Special Inspectors and the Architect and Structural Engineer may inspect any portion of the structure.
1. Means of access includes, but is not limited to, ladders, and/or scaffolds.

2.11 ACCESS ROADS AND PARKING AREAS

- A. Prior to starting work, the Contractor, District and the Architect or his representative shall make a thorough survey of the site and approaches thereto. The Contractor will maintain temporary access roads required to perform the work and locate construction offices at locations approved by the Architect/Engineer and the District. The Contractor shall verify all grade elevations indicated

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on the Drawings at the site and immediately notify the Architect/Engineer if any deviations are found. The Contractor shall assume all responsibility if any work proceeds without such notification.

- B. Maintain specific vehicular access as required for the orderly progress of the work. Fill, compact and grade areas as necessary to provide suitable support during all weather conditions for anticipated loads including municipal fire apparatus. Provide adequate surface drainage and do not interrupt natural flow of existing drainage.
- C. Provide designated parking areas for use by construction personnel.
- D. Restore temporary vehicular access and parking areas to original or to specified conditions at completion of work.

2.12 TEMPORARY CONTROLS

- A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and related areas under Contractor's control; remove physical evidence of temporary facilities at completion of work.
- B. Dust Control: Provide positive methods and apply dust control materials and methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere.
- C. Water Control: Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.
 - 1. Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.
 - 2. Provide, operate and maintain hydraulic equipment of adequate capacity to control surface water.
 - 3. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.
- D. Pollution Control:

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1. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.
 2. Provide equipment and personnel; perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.
- E. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.
1. Take special measures to prevent harmful substances from entering public waters and atmosphere.
 - a. Prevent disposal of wastes, effluent, chemicals, or other such substances in sanitary or storm sewers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
 1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

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2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.
 4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect, and will not be accepted as a basis of claims for a Change Order.
- B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use. Water may be taken from existing site water supply.
1. Sterilization: Sterilize temporary water piping prior to use.
- C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.

3.3 PROJECT IDENTIFICATION AND SIGNS

- A. Project Identification and Temporary Signs: Prepare project identification and other signs of the size indicated; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel. Do not permit installation of unauthorized signs.
- B. Provide temporary on-site informational signs.
1. As required by codes, laws and regulatory agencies.
 2. To identify key elements of the construction facilities.
 3. To direct traffic.
- C. Project Identification Sign: Size, design and information lettered as specified and as shown on drawing located at the end of this section. Finish with 3 coats of paint. Locate sign as indicated or directed by the Architect and School District.

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3.4 OWNERSHIP OF TEMPORARY FACILITIES AND CONTROLS

- A. Items provided by the Contractor under this section shall remain the property of the Contractor and shall be removed from the job site immediately upon completion of the work.

3.5 COLLECTION AND DISPOSAL OF WASTE

- A. Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.6 OPERATION, TERMINATION AND REMOVAL

- A. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of the Contractor. The School District reserves the right to take possession of Project identification signs.

END OF SECTION

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PRODUCT OPTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section establishes procedures for specified product options.
- B. The intent of this section is to insure that specified product options exceed or equal the quality of the specified products and are furnished and installed in accordance with the design intent.
- C. This Section does not apply to any substitution requests that should have been made at time of bid in accordance with the Instructions to Bidders and the bid documents. The District can reject any requests for substitution in its sole discretion if the Contractor did not submitted a request at the time of bid in accordance with the Instructions to Bidders and the bid documents.

1.2 RELATED SECTIONS

- A. Information for Bidders
- B. Instructions to Bidders
- C. General and Supplementary Conditions
- D. Section 01 25 00- Contract Modification Procedures
- E. Section 01 33 00 - Submittal Procedures
- F. Section 01 63 00 - Product Substitution Procedures

1.3 PRODUCT OPTIONS

- A. Where product options are included in the specifications sections and are specified by naming more than one, or several acceptable products or manufacturers, select any product or manufacturer listed.
 - 1. Where more than one manufacturer or product is listed in the specifications and only one manufacturer or product is specified in detail with model numbers and features, the one specified in detail shall be considered the standard of quality required for all manufacturers or products listed.

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- B. Where product options are included in the specifications and they are followed by an "or equal " or "approved equal" or equal meeting a specified standard, review and approval by the Architect/Engineer and School District is required for Contractor-proposed equal items. Procedures specified in Section 01630 are to be followed.
- C. For items specified only by Reference Standards, select any item meeting standards.
- D. Performance Specifications: For items specified by performance requirements, select any item meeting the performance standards specified.
- E. Descriptive Specifications: When specifications describe a product or assembly, listing exact components and characteristics, without the use of a brand or trade name, provide a product or assembly that contains the components and characteristics specified.
- F. Compliance with Standards Specifications: When specifications only require compliance with a Code, Regulation or Voluntary Standard, Provide products that comply with the specified Codes, Regulations or Standards.
- G. Submit request, as required for substitution, for any item or manufacturer not specifically named in the specifications on the Substitution Request Form enclosed with the Bidding Documents.
 - 1. Architect/Engineer and School District will determine acceptability of proposed substitutions.
 - 2. The Compton Community College District has a Resolution: No. 2009-10-21 and 2015-16-50 for the Designation of Specific Material, Product, or Service for numerous District Standard product and systems. (see attached resolutions for details).

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

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PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section establishes procedures for Contractor submittal of substitutions. This Section does not apply to any substitution requests that should have been made at time of bid in accordance with the Instructions to Bidders and the bid documents. The District can reject any requests for substitution in its sole discretion if the Contractor did not submitted a request at the time of bid in accordance with the Instructions to Bidders and the bid documents.
- B. This Section provides procedures for review and compliance with Public Contract Code section 3400 for the "or equal" clause allowing bidders to furnish any equal material, product, thing or service. Or equal items proposed by bidders are considered substitutions and are subject to approval of the Architect and School District. Burden of proof for "Or Equals" is the responsibility of the Contractor.
- C. The intent of this section is to insure that proposed substitutions exceed or equal the quality of the specified products and are furnished and installed in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. Information for Bidders
- B. General and Supplementary Conditions
- C. Section 01 62 00 - Product Options
- D. Section 01 25 00- Contract Modification Procedures

1.3 SUBSTITUTIONS

- A. Substitution requests are to be submitted by Generals Contractors Only. Requests submitted by Subcontractors, Material Suppliers, Manufacturers and other interested parties, other than General Contractors, will not be considered. Submit requests on the attached **SUBSTITUTION REQUEST FORM (AFTER BID)** in section 1305. **Substitution requests will only be considered for**

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an “or equal” product specifically listed in the technical specifications for this project. No other substitutions will be considered. (ie if Carrier AC units are used on plans and specifications say “Carrier, Trane or York” – Trane or York would be considered as a substitution.)

- B. Comply with provisions of Articles for Substitutions in the Information for Bidders, General Conditions and any modifications to these documents provided in the Supplementary Conditions.
- C. Tabulate products by specification section number and title.
- D. Submit separate request for each substitution. Support each request with the information and documents below and any other requirements in the General Conditions Article 3.10.:
 - 1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - i. Product description.
 - ii. Reference standards.
 - iii. Performance and test data.
 - iv. Fire resistance and fire ratings.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
 - 2. Itemized comparison of the proposed substitution with product specified; list significant variations.
 - 3. Any effect the substitution may have on other trade contracts.
 - 4. List of changes required in other work or products.

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5. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any change in cost.
 6. Designation of required license fees or royalties.
 7. Designation of availability of maintenance services, sources of replacement materials.
 8. Comparison of physical size and weight with product specified.
 9. Comparison of physical shape and available finishes.
- E. Substitutions will not be considered for acceptance when:
1. They are indicated or implied on shop drawings or product data submittals and where not approved in compliance with the General Conditions and this section.
 2. Substitution request procedures included in this Section, the Information for Bidders, and in the General and Supplementary Conditions are not complied with by the Contractor.
 3. The School District has determined that compatibility, standardization, technological sophistication, service and uniformity are necessary with regard to technological and certain safety items across the Schools in the District.
 4. The request for substitution, as determined by the District, should have been submitted at the time of bid in accordance with the Instructions to Bidders and the bid documents.
- F. Substitute products shall not be installed in the construction without written acceptance of the Architect and School District.
- G. Architect and School District will determine acceptability of proposed substitutions prior to awarding of the Contract. Substitutions may be approved after award of the Contract only where the following conditions exist and only at the School District's sole discretion:

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1. Specified item has been discontinued or is not available to meet project schedule.
2. The School District requested the Substitution.
3. Substitution will reduce the Contract Amount and Contract Time (Credit Back to the District) without reducing quality.

1.4 CONTRACTOR'S SUBSTITUTION CERTIFICATION

- A. In making formal request for substitution contractor certifies that:
1. He has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.
 2. He will provide same warranties or bonds for substitution as for product specified.
 3. He will coordinate installation of accepted substitution into the work, and will make such changes as may be required for the work to be complete in all respects including modification of the work of other trades.
 4. He waives claims for additional costs caused by substitution which may subsequently become apparent.
 5. Substituted material is similar in physical appearance, size and weight and will install with the same opening and attachments.
 6. Substituted material has the same or better fire rating and fire resistive qualities, including flame spread, smoke developed, UL tested and listing.
 7. Meets all requirement set forth in the General Conditions Article 3.10.

1.5 ARCHITECT'S/ENGINEER'S DUTIES

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

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1.6 AVAILABILITY OF SPECIFIED ITEMS

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

1.7 SUBSTITUTION WARRANTY REQUIREMENTS

- A. Submit with the substitution request an executed Substitution Warranty. The Form is provided at the end of this Section. This form shall apply to substitutions submitted for acceptance prior to bid, prior to award of contract and for substitutions required after contract has been executed.
- B. The Contractor is to warrant, in writing on company letterhead, that the substituted items are to perform as specified, and assume complete responsibility for the same. This includes responsibility and costs required for modifications to building, other materials, or equipment, and any additional coordination with work of other trades. The Contractor if required or requested by the Architect or School District shall pay for testing, of Substitution proposed.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

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CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Cleaning throughout the construction period and final project cleaning prior to the acceptance tour.
- B. Related Work Described Elsewhere: In addition to standards specified herein, comply with requirements for cleaning as described in other sections of these Specifications.

1.2 QUALITY ASSURANCE

- A. Inspection: Conduct daily inspection, and more often if necessary, to verify that requirements of cleanliness are being met.
- B. Codes and Standards: In addition to the requirements specified herein, comply with pertinent requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

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

2.2 COMPATIBILITY

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

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

- A. General:
 - 1. Retain stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
 - 2. Do not allow the accumulation of scrap, debris, waste materials, and other items not required for construction of this work. Debris

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shall be removed from the site and disposed of in a lawful manner. Disposal receipts of dump tickets shall be furnished to Architect/Engineer upon request.

3. At least twice each month, and more often if necessary, remove scrap, debris, and waste material from the job site.
4. Provide adequate storage for items awaiting removal from the job site, observing requirements for fire protection and protection of the ecology.

B. Site:

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

C. Structures:

1. Daily, and more often if necessary, inspect the structures and pick up scrap, debris, and waste material. Remove items to the place designated for their storage.
2. Daily, and more often if necessary, sweep interior spaces clean.
 - a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other materials capable of being removed by use of reasonable effort and a handheld broom, i.e., "broom-clean".
3. As required preparatory to installation of succeeding materials, clean the structures of pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the required cleanliness.
4. Following the installation of finish floor materials, clean the finish floor daily, and more often if necessary, and while work is being performed in the space in which finish materials have been installed.

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- a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from foreign material that, in the opinion of the Architect, may be injurious to the finish floor material, i.e., "vacuum- clean".

3.2 FINAL CLEANING

- A. Definition: Except as otherwise specifically provided, "clean", for the purpose of the Article, shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials, i.e., "scrub and polish clean".
- B. General: Prior to completion of the work, remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste and conduct final progress cleaning as described above.
- C. Site: Unless otherwise specifically directed by the Architect, water and broom clean paved areas on the site and public paved areas directly adjacent to the site. Remove resultant debris.

D. Structures:

1. Exterior: In areas affected by the work under this contract, visually inspect exterior surfaces and remove traces of soil, waste material, smudges, and other foreign matter. Remove traces of splashed material from adjacent surfaces. If necessary to achieve a uniform degree of exterior cleanliness, hose down the exterior of the structure.

In the event of stubborn stains not removable with water, the Architect may require light sandblasting or other cleaning at no additional cost to the Owner.

2. Interior: In areas affected by the work under this contract, visually inspect interior surfaces and remove traces of soil, waste material, smudges, and other foreign matter. Remove traces of splashed materials from adjacent surfaces. Remove paint drippings, spots, stains, and dirt from finished surfaces. Use only the cleaning materials and equipment instructed by the manufacturer of the surface material.
3. Glass: Clean glass inside and outside.
4. Polished surfaces: On surfaces requiring the routine application or buffed polish, apply the polish recommended by the manufacturer of the material being polished. Glossy surfaces shall be cleaned and shined as intended by the manufacturer.

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- E. Timing: Schedule final cleaning as accepted by the Architect to enable the Owner to accept a completely clean project.

3.3 CLEANING DURING OWNER'S OCCUPANCY

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

END OF SECTION

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FIELD ENGINEERING

PART 1 - GENERAL

1.1 SUMMARY

- A. General: This Section specifies administrative and procedural requirements for field engineering services, including, but not necessarily limited to, the following:
 - 1. Land survey Work.
 - 2. Civil engineering services.
 - 3. Structural engineering services.

1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittals
- B. Section 31 00 00 - Earthwork

1.3 SUBMITTALS

- A. Certificates: Submit a certificate signed by the Land Surveyor or Professional Engineer certifying that the location and elevation of improvements comply with the Contract Documents. These Surveys and updated "As-Builts" will be submitted with every pay application for review and acceptance by the Engineer and Inspector of Record.
- B. Submittal Copies of final as built property survey.
- C. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Sections "Submittals", "Project Closeout", and Specification Number 01 78 20 – "Project Record Documents".

1.4 QUALITY ASSURANCE

- A. Surveyor: Engage a Registered Land Surveyor registered in the State where the project is located, to perform land surveying services required.

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- B. Engineer: Engage a Professional Engineer of the discipline required, registered in the state of California, in which the Project is located, to perform required engineering services.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The District will identify existing control points and property line corner stakes.
- B. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks before preceding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points (if any) during construction.
 - 1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
 - 2. Promptly replace lost or destroyed project control points. Base replacements on the original survey control points.
- C. Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- D. Existing utilities and equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction. Contact underground service alert at 1(800) 422-4133 before start of construction.
 - 1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.

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3.2 PERFORMANCE

- A. Working from lines and levels established by the survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
 - 1. Advise entities engaged in construction activities, of marked lines and levels provided for their use.
 - 2. As construction proceeds, check every major element for line, level and plumb.
- B. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.
 - 1. Record deviations from required lines and levels, and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
 - 2. On completion of foundation walls, major site improvements, and other Work requiring field engineering services, prepare a certified survey showing dimensions, locations, angles and elevations of construction and site work.
- C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.
- D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical Work.
- E. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by construction. Coordinate with local authorities having jurisdiction.

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- F. Final Property Survey: Before Substantial Completion, prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the Surveyor, to the effect that principal metes, bounds, lines and levels of the Project are accurately positioned as shown on the survey.

END OF SECTION

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CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting and patching, and interface of new work into existing construction and with work being performed under other contracts provided by the School District.
- B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the work.
 - 1. Requirements of this Section apply to Sections in Divisions 2 through 16.

1.2 RELATED SECTIONS

- A. Section 01 01 00 - Summary of work (Scope of Work).
- B. Section 03 30 00 - Cast-in-place Concrete
- C. Division 2 through 16 Sections

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required and how it is to be performed.
 - 2. Indicate dates when cutting and patching is to be performed.
 - 3. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
 - 4. Refer to Structural Drawing for locations where cutting and patching involves addition of reinforcement to structural

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elements. Do not damage or weaken existing structural elements.

5. Approval by the Architect/Engineer to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the work found to be unsatisfactory.

1.4 QUALITY ASSURANCE

- A. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's/Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse

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weather conditions for portions of the Project that might be exposed during cutting and patching operations.

- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Take all precautions necessary to avoid cutting existing pipe, electrical wire and conduit or ductwork serving the building.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
 - 2. Where patching occurs in a smooth painted surface, extend final paint coat over entire surface containing the patch, after the patched area has received primer and second coat.
 - 3. Cut, patch, point-up and repair plaster to accommodate other construction and to repair cracks, dents and imperfections.
 - 4. Cut, patch, restore and repair all gypsum board wall and ceiling surfaces where new pipes, equipment, clocks, switches, conduit, ducts and any new construction items that would damage or cut existing surfaces.
 - 5. Cut patch and repair existing concrete and asphalt paving where new utility lines are installed across existing paving and under existing concrete floor slabs. Site verify extent of cutting and patching required. All existing site improvements may not be indicated on the site plan and floor plans.
 - 6. Cut existing walls, floors, ceilings and roofs or other parts of building structure to accommodate new ducts, conduits and piping, patch and repair existing.
 - 7. Patch existing floors, walls, roofs and ceilings where existing ducts, conduit, equipment, water, gas, sewer, windows, doors etc. that are not used or removed and are not to be

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replaced. This is considered part of required general patching and is part of the contract and will not be shown in detail on the Contract drawings. Field verify with existing site and building construction for patching required.

3.4 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged areas to their original condition.

END OF SECTION

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WARRANTIES, GUARANTIES AND BONDS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section specifies general requirements for written warranties, guaranties and bonds required by the Contract Documents.
- B. Submittal to, and approval by, the District of the warranties, guaranties and bonds are prerequisites to final payment under the Contract.

1.2 RELATED WORK

- A. Related work specified elsewhere:
 - 1. General Conditions –Section 00 72 00 Article 13
 - 2. Contract Close-out - Section 01 77 00

1.3 TIME PERIOD

- A. Deliver manufacturers' warranties, guaranties and bonds required by Contract Documents, with District named as beneficiary. For equipment and machinery, or components thereof, bearing a manufacturer's warranty or guaranty that extends for a longer time period than the Contractor's warranty and guaranty, deliver manufacturer's warranties or guaranties in same manner.

1.4 FORM

- A. Written warranties and guaranties, excepting manufacturer's standard printed warranties and guaranties shall be submitted on the Contractor's, Subcontractors, material suppliers', or manufacturers' own letterhead, addressed to District. Warranties and guaranties shall be submitted in duplicate, and in the form shown on the following page, signed by all pertinent parties and by Contractor in every case, with modifications as approved by District to suit the conditions pertaining to the warranty or guaranty.

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1.5 SUBMITTAL

- A. The Contractor shall collect and assemble written warranties and guaranties from all subs, material suppliers and manufacturers into a bound booklet form, and deliver the bound books to Architect/Engineer for delivery to the District's attorney for final review and approval.
- B. Submit required warranty/guaranty on letterhead of Contractor responsible for each type of Work in accordance with attached sample form.
- C. The contractor will ensure that the Manufacturers will be scheduled in a timely manner to ensure that the start of the warranty period is well documented.

END OF SECTION

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CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the work.
- B. Related Requirements in Other Parts of the Project Manual:
 - 1. Fiscal provisions, legal submittals and additional administrative requirements: Conditions of the Contract.
- C. Comply with requirements set forth in General Conditions Article 9.

1.2 SUBSTANTIAL COMPLETION

- A. When Contractor considers the work is substantially complete as defined in the General Conditions, he shall submit to Architect/Engineer:
 - 1. A written notice that the work, or designated portion thereof, is substantially complete.
 - 2. A list of items to be completed or corrected.
 - 3. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- B. When Architect/Engineer concurs that the work is substantially complete, he will:
 - 1. Prepare a letter of Substantial Completion accompanied by Contractor's list of items to be completed or corrected, as verified and amended by the Architect.
 - 2. Submit the Certificate to Owner and Contractor for their written acceptance of the responsibilities assigned to them.

1.3 FINAL INSPECTION

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- A. When Contractor considers the work is complete, he shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 - 5. Work is completed and ready for final inspection.
 - 6. The Architect's/Engineer's final inspection list of items to be completed or corrected, has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect/Engineer.
 - 7. Submit consent of surety to final payment.
 - 8. Submit a final liquidated damages settlement statement.
 - 9. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Architect/Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. When the Architect/Engineer finds that the work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.4 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect's reference during normal working hours.
- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings.

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Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
 2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
 3. Note related Change Order numbers where applicable.
 4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set per Specification 01 78 20 Project Record Documents.
- C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following, where applicable, in accordance with the General Conditions and Specifications:
1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties, guarantees and bonds.
 4. Keys and keying schedule.

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5. Spare parts and extra stock.
 6. Other items as required by the Specifications.
- B. Deliver Certificate of Compliance and Test Report as follows:
1. Sterilization of water systems.
 2. Testing of sewer systems.
 3. Testing of hot and cold water systems.
 4. Testing of gas system.
 5. Testing of lighting, power and alarm systems.
 6. Testing of HVAC equipment and exhaust fans.

1.6 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
1. Maintenance manuals.
 2. Record documents.
 3. Spare parts and materials.
 4. Tools.

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5. Identification systems.
 6. Control sequences.
 7. Hazards.
 8. Cleaning.
 9. Warranties and bonds.
 10. Maintenance agreements and similar continuing commitments.
- B. As part of instruction for operating equipment, demonstrate the following procedures:
1. Start-up.
 2. Shutdown.
 3. Emergency operations.
 4. Noise and vibration adjustments.
 5. Safety procedures.
 6. Economy and efficiency adjustments.
 7. Effective energy utilization.

3.2 FINAL CLEANING

- A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities".
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
1. Complete the following cleaning operations before requesting inspection for Final Completion.
 - a. Remove labels that are not permanent labels.

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- b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
 - d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
 - e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
- C. Pest Control: Engage an experienced exterminator to make a final inspection, and rid the Project of rodents, insects and other pests.
- D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.
1. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION

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PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Maintain at the site for the School District, one record copy of:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change Orders and other Modifications to the Contract
 - 5. Architect/Engineer written instructions
 - 6. Approved Shop Drawings, Product Data and Samples.
 - 7. Field Test Records
 - 8. Construction Photographs.

1.2 RELATED SECTIONS

- A. General Conditions – 00 72 00
- B. Section 01 31 00 - Project Coordination
- C. Section 01 33 00 - Submittals
- D. Section 01 30 50-31 - Contract Closeout
- E. Section 01 72 20 – Field Engineering

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide locked cabinet or secure storage space for storage of samples.

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- B. File documents and samples in accordance with CSI/CSC Master Format.
- C. Maintain documents in a clean, dry legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for inspection by School District.

1.4 MARKING DEVICES

- A. Provide felt-tip marking pens for recording information in the color code designated by Owner.

1.5 RECORDING

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
- C. Drawings: Legibly mark to record actual construction:
 - 1. Depth of various elements of foundation in relation to finish first floor datum.
 - 2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 - 4. Field changes of dimension and detail.
 - 5. Changes made by Addenda, Supplemental Instruction Construction Change Directive or by Change Order.
 - 6. Details not on original contract drawings.
 - 7. Revisions to electrical circuitry and locations of electrical Devices and equipment

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8. Identify each record drawing with the written designation of "RECORD DRAWING" in a prominent location.
- D. Specifications and Contract Document Modifications: Legibly mark each Section to record:
1. Manufacturer, trade name, catalog number, and Supplier of each Product and item of equipment actually installed.
 2. Supplier and Installer's name and contact information.
 3. Changes made by Addenda, Supplemental Instructions, and Construction Change Directive or by Change Order.
- E. Record Digital Data Files: Immediately before inspection for Substantial Completion, review marked-up record prints with Architect/Engineer, Construction Manager and Project Inspector. 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.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw and add new details and notations where applicable.
 4. Refer instances of uncertainty to Architect/Engineer (through Construction Manager) for resolution.
 5. Architect/Engineer will furnish Contractor one set of digital files of the Contract Drawings, complete on same set, with all Addenda, clarifying Request for Information, Instruction Bulletins, Construction Change Documents, or any other changes, for use in recording information. Digital files shall be in AutoCAD (latest version) and PDF format.
 - a. Refer to section 01 33 00 "Submittal Procedures" for requirements related to use of architect's/engineer's digital data files.
 - b. Architect/Engineer will provide data file layer information. Record mark-ups in separate layers.

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- F. Record Drawings Labeling: Provide Hard copy and Digital copy (in PDF format) as follows:
1. Provide a Flash Drive for all Digital Record Drawing submittals with a letter of transmittal describing all contents and date of contents on the Flash Drive.
 2. Provide a folder in the Digital submittal labeled in capital letters naming the project i.e. CCC-051 PUBLIC SAFETY BUILDING.
 3. Provide sub-folders labeled in capital letters with the category and date of the as-builts i.e. CCC-051 PUBLIC SAFETY BUILDING – AS-BUILTS (CONTRACTORS NAME).
 4. Provide separate files in sub-folders labeled with drawing number and description i.e. FA0.0 Title.
 5. Submit documents to Architect/Engineer (through the Construction Manager) with claim for final Application for Payment.
 6. Final 5% retention will be held until as-builts are complete.

1.6 SUBMITTALS

- A. At the completion of the Project, deliver Record Documents to the Compton Community College District (through the Construction Manager). Architect/Engineer shall review documents for compliance with requirements as described above.
- B. Accompany submittal with transmittal letter in duplicate, containing:
1. Date
 2. Project title and number
 3. Contractor's name and address
 4. Title and number of each Record Document
 5. Signature of Contractor or his authorized representative
- C. Prior to the date of Substantial Completion the Contractor is to meet with the architect/engineer to determine which Samples

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maintained during construction are to be transferred to the School District. Dispose of all samples not be saved.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

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OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for operating and maintenance manuals including the following:
 - 1. Preparation and submittal of operating and maintenance manuals for building operating systems and/or equipment.
 - 2. Instruction of the School District's operating personnel in operation and maintenance of building systems and equipment.
- B. Special operating and maintenance data requirements for specific pieces of equipment or building operating systems are included in the appropriate Sections of Divisions 2 through 16.

1.2 QUALITY ASSURANCE

- A. Maintenance Manual Preparation: In preparation of Maintenance Manuals, use personnel thoroughly trained and experienced in operation and maintenance of the equipment or system involved.
 - 1. Where written instructions are required, use personnel skilled in technical writing to the extent necessary for communication of essential data.
 - 2. Where Drawings or diagrams are required, use draftsmen capable of preparing Drawings clearly in an understandable format.
- B. Instructions for the School District's Personnel: For instruction of the School District's operating and maintenance personnel, use experienced instructors thoroughly trained and experienced in the operation and maintenance of the building equipment or system involved.

1.3 SUBMITTALS

- A. Submittal Schedule: Comply with the following schedule for submittal of operating and maintenance manuals.

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1. Before Substantial Completion, when each installation that requires submittal of operating and maintenance manuals is nominally complete, submit two draft copies of each manual to the Architect/Engineer for review. Include a complete index or table of contents of each manual.
- B. Form of Submittal: Prepare operating and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.
1. Binders: For each manual, provide heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2" by 11" paper. Provide a clear plastic sleeve on the spine, to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - a. Where two or more binders are necessary to accommodate data, correlate data in each binder into related groupings in accordance with the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.
 - b. Identify each binder on the front and spine, with the typed or printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name, and subject matter covered. Indicate the volume number for multiple volume sets of manuals.
 2. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 3. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if it is not available, specially prepared data, neatly typewritten, on 8-1/2" by 11", 20 pound white bond paper.
 4. Drawings: Where drawings or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind in with the text.

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- a. Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a fold-out.
- b. If drawings are too large to be used practically as a fold-out, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location in the manual.

1.04 MANUAL CONTENT

- A. In each manual include information specified in the individual Specification Section, and the following information for each major component of building equipment and its controls:
 1. General system or equipment description.
 2. Design factors and assumptions.
 3. Copies of applicable Shop Drawings and Product Data.
 4. System or equipment identification, including:
 - a. Name of manufacturer.
 - b. Model number.
 - c. Serial number of each component.
 5. Operating instructions.
 6. Emergency instructions.
 7. Wiring diagrams.
 8. Inspection and test procedures.
 9. Maintenance procedures and schedules.
 10. Precautions against improper use and maintenance.
 11. Copies of warranties.
 12. Repair instructions including spare parts listing.

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13. Sources of required maintenance materials and related services.
 14. Manual Index.
- B. Organize each manual into separate Sections for each piece of related equipment. As a minimum each manual shall contain a title page, a table of contents, copies of Product Data, supplemented by drawings and written text, and copies of each warranty, bond and service Contract issued.
1. Title Page: Provide a title page in a transparent plastic envelope as the first sheet of each manual. Provide the following information:
 - a. Subject matter covered by the manual.
 - b. Name and address of the Project.
 - c. Date of submittal.
 - d. Name, address, and telephone number of the Contractor.
 - e. Name and address of the Architect;
 - f. Cross reference to related systems in other operating and maintenance manuals.
 2. Table of Contents: After the Title Page, include a typewritten table of contents for each volume.
 3. General information: Provide a general information Section immediately following the Table of Contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the Subcontractor or installer, and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. In addition, list a local source for replacement parts and equipment.
 4. Product Data: Where manufacturer's standard printed data is included in the manuals, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation.

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5. **Written Text:** Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written text to provide necessary information. Organize the text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.
6. **Drawings:** Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
7. **Warranties, Bonds and Service Contracts:** Provide a copy of each warranty, bond or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to be followed in the event of product failure. List circumstances and conditions that would affect validity of the warranty or bond.

1.05 MATERIAL AND FINISHES MAINTENANCE MANUAL

- A. **Architectural Products:** Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.
 1. **Care and Maintenance Instructions:** Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information regarding cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.
- B. **Moisture-Protection and Weather-Exposed Products:** Provide complete manufacturer's data with instructions on inspection, maintenance and repair of products exposed to the weather or designed for moisture-protection purposes.

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1.06 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

- A. Manufacturer's Information: For each manufacturer of a component part or piece of equipment provide the following:
 - 1. Printed operating and maintenance instructions.
 - 2. Assembly drawings and diagrams required for maintenance.
 - 3. List of items recommended to be stocked as spare parts.

- B. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:
 - 1. Routine operations.
 - 2. Trouble-shooting guide.
 - 3. Disassembly, repair and reassembly
 - 4. Alignment, adjusting and checking.

- C. Operating Procedures: Provide information on equipment and system operating procedures, including the following:
 - 1. Start-up procedures.
 - 2. Equipment or system break-in.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Shut-down and emergency instructions.
 - 7. Summer and winter operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating Instructions.

- D. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

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- E. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
- F. Coordination Drawings: Provide each Contractor's Coordination Drawings.
 - 1. Provide as-installed color-coded piping diagrams, where required for identification.
- G. Valve Tags: Provide charts of valve tag numbers, with the location and function of each valve.
- H. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panel boards, including the following:
 - 1. Electric service.
 - 2. Controls.
 - 3. Communication.

1.07 INSTRUCTIONS TO SCHOOL DISTRICT PERSONNEL

- A. Prior to final inspection, instruct School District personnel in operation, adjustment, and maintenance of products, equipment and systems. Provide instruction at mutually agreed upon times.
 - 1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
 - 2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

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COMMISSIONING

PART 1 – GENERAL

1.1 SUMMARY

- A. Commissioning is a process for validating and documenting that the facility and its systems are constructed and perform in conformity with the Contract Documents.
- B. The objective of the commissioning process is to verify that the performance of the facility and its systems meet or exceed the design intent.
- C. Commissioning includes special facility start-up processes used to bring the facility to a fully operational state, free of deficiencies in an efficient and timely manner
- D. Training on related systems and equipment operation and maintenance shall be scheduled to commence only after start-up is complete and systems are verified to be 100% complete and functional.

1.2 DESCRIPTION

- A. The following applies to all Contract Documents
 - 1. Contractor Startup: Sub-phase of Contractor's work ending with Acceptance of Work, during which Contractor performs a pre-planned program of activities including starting, testing, inspecting, adjusting balancing, correcting deficiencies and other similar activities.
 - a. The Construction Manager, Architect/Engineer, Consultants and the DSA Inspector of Record (IOR) shall be present to observe, inspect and identify deficiencies in Building Systems Operations.
 - 2. The completion of startup means the entire Construction Project including startup and fine tuning has been performed to the requirements of the Contract Documents and is verified in writing by the Construction Manager, Architect/Engineer and the Consultants.

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3. Fine Tuning: Fine tuning is the responsibility of Contractors after District occupancy and ending one year after District occupancy. During this time the Contractor is responsible for optimizing systems and correcting deficiencies arising under normal operating conditions.
 - a. Includes a period after occupancy where systems are optimized under "live" operating conditions and any outstanding construction deficiencies are corrected.
 - b. Fine Tuning shall extend from date of District occupancy to one year after occupancy.

1.3 RELATED SECTIONS – (Not Applicable)

1.4 DEFINITION OF TERMS

- A. Contractor's Pre-Commissioning Checklists: Includes installation and start-up items as specified to be completed by the appropriate contractors prior to operational verification through the functional testing process.
- B. Installation Verification Process: Includes the on-site inspection and review of related system components for conformance to Contract Documents. The Contractor shall verify systems readiness for functional testing procedures prior to the start of functional testing. Deficiencies will be documented by the Inspector for future resolution.
- C. Functional Performance Testing Process: Includes the documented testing of system parameters, under actual or simulated operating conditions. Final performance commissioning of systems will begin only after the appropriate Contractor certifies that systems are 100% complete and ready for functional testing. The contractors will be required to schedule, coordinate and perform device tests, calibration and functional performance test procedures.
- D. Deficiencies and Resolutions List: Includes a list of noted deficiencies discovered as a result of the commissioning process. This list also includes the current disposition of issues, and the date of final resolution as confirmed by the Construction Manager and Inspector. Deficiencies are defined as those issues where products execution or performance does not satisfy the Project Contract Documents and/or the design intent.

1.5 COMMISSIONING SCHEDULE

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- A. Provide schedules for Contractor Start-Up work.
- B. Incorporate in overall construction schedule.
- C. Contractor's activities, which will be performed as specified under Fine Tuning, shall be completed within one year from date of occupancy by the District.

1.6 SUBMITTALS

- A. Submit Draft and Final Contractor Start-up Forms as described in this Section. Submit Draft Report for Construction Manager and Architect's review and comment prior to Final Submission.
- B. Prepare and submit one copy of report form to be used in preparation of system reports for:
 - 1. Each mechanical system as required
 - 2. Each Electrical & low voltage system as required.
- C. Each System Report shall be submitted including the following:
 - 1. Project Name
 - 2. Name of System
 - 3. Manufacturer's equipment start-up reports.
 - 4. Systems' testing, balancing, and adjusting reports.
 - 5. Equipment Report Forms shall include the following: Project name, name of equipment, starting and testing procedures to be performed and observations and test results to be recorded.

1.7 COMMISSIONING DUTIES AND RESPONSIBILITIES

- A. Contractors Duties and Responsibilities:
 - 1. Assure the participation and cooperation of Subcontractors and Suppliers under their jurisdictions as required to complete the commissioning process.

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2. Complete Commissioning Report Forms. Reports are to be completed in a neat easily readable condition.
3. Complete the respective start-up and check out procedures and insure readiness of equipment and systems prior to the start of the functional performance testing.

Written confirmation of system readiness for performance testing is required.

4. Provide qualified representatives for the functional performance commissioning process.
5. Assure that all subcontractors, suppliers, test and balance, controls, etc. include in there respective contracts cost necessary to participate in and complete the commissioning process.

B. Duties and responsibilities of others for Commissioning:

1. The commissioning process requires the active participation of the Construction Manager, School District, Mechanical Engineer, Electrical Engineer, and any other related Consultants on the project.

1.8 SYSTEM FAILURES

- A. After a second failure of a system to successfully meet the criteria as set for in the functional performance testing process, the contractor shall reimburse the School District for cost associated with any additional retesting required due to uncorrected deficiencies. Costs shall include salary, benefits, overhead, travel costs and per diem lodging costs if applicable.

PART 2 – PRODUCTS - (Not Applicable)

PART 3 – EXECUTION - (Not Applicable)

END OF SECTION

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building demolition .
- B. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- B. Section 31 20 00 - Earthwork: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 DEFINITIONS

- A. Remove: Remove and legally dispose of items, except those identified for use in recycling, re-use, and salvage programs.
- B. 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.
- C. 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.
- D. 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.
- E. 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.

- F. Chemical Waste: Includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals and inorganic wastes.
- G. 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.
- H. Reuse: The use, in the same or similar form as it was produced, of a material which might otherwise be discarded.
- I. 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.

1.05 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. Refer to sequence requirements specified in Section 01 10 00 - Summary; and construction progress schedule requirements specified in Section 01 32 16 - Construction Progress Schedule.

1.06 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain property of Compton Community College 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 salvagable items to determine if District wants to retain ownership, and discuss Contractor's Waste Management and Recycling Plan.

1.07 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

- B. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.
 - 2. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - 2. Identify demolition firm and submit 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.
- 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 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. 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.
- C. Comply with other requirements specified in Section 01 70 00.
- D. 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.
- E. 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. Confine demolition activities to areas defined by public roads, easements, and work area limits indicated on the drawings.
 - 3. Temporary Construction: Remove indications of temporary construction facilities, such as haul roads, work areas, structures, stockpiles or waste areas.
 - 4. 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.
 - 5. 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.
 - 6. 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. Repetitive impact noise on the property shall not exceed the following dB limitations:

Sound Level in dB	Time Duration of Impact Noise
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

- b. Provide equipment, sound-deadening devices, and take noise abatement measures that are necessary to comply with the requirements of this Contract.
 - c. At least once every five successive working days while work is being performed above 55 dB noise level, measure sound level for noise exposure due to the demolition.
 - 1) Measure sound levels on the 'A' weighing network of a General Purpose sound level meter at slow response.
 - 2) To minimize the effect of reflective sound waves at buildings, measurements may be taken three to six feet in front of any building face.
- F. 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.
 - 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 permit.
 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.
- G. Do not begin removal until receipt of notification to proceed from District.
- H. Do not begin removal until built elements to be salvaged or relocated have been removed.
- I. Protect existing structures and other elements that are not to be 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.
- J. 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.
- K. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- L. 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.
- M. 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.
- N. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.

3.02 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their 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. 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 utilities to be subsequently reconnected, in same manner as other utilities to remain.
- I. Utility Lines, Posts and Structures:
 - 1. Work by Utility: Posts, conductors, guy wires, boxes, structures and equipment shown to be cleared or removed by the responsible utility company or agency shall be considered work under a separate contract.
 - 2. Coordination: The Contractor shall arrange, schedule and coordinate work by utility companies and agencies.
 - 3. Payment: Costs, if any, imposed by utility companies and agencies shall be included in the Contract Sum.

3.03 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all 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.
- E. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1-GENERAL

1.1 SUMMARY

A Provisions of the General and Supplementary Conditions and Division One apply to this section.

B Section Includes: Furnishing all labor, materials and equipment necessary for demolition, dismantling, cutting and alterations as indicated, specified, and required for completion of the Contract, as applicable. Includes items such as the following:

- 1 Protecting existing work to remain.
- 2 Cleaning soiled materials that are to remain.
- 3 Disconnecting and capping utilities.
- 4 Removing debris and equipment.
- 5 Removal of items indicated on Drawings.
- 6 Salvageable items to be retained by the Owner as indicated on the Drawings and during the pre-construction job walk.

C Related Sections:

- 1 Section 312000: Earthwork

1.2 QUALITY ASSURANCE

A Comply with the following:

- 1 Applicable codes, ordinances, regulations of local, municipal, state and federal authorities having jurisdiction.
- 2 Comply strictly to Rule 403 Fugitive Dust, South Coast Air Quality Management District.
- 3 Obtain necessary permits and notices, post where required.
- 4 Comply with safety requirements of the local fire department.
- 5 Comply with ANSI A10.6.

B Notify affected utility companies before starting Work and comply with their requirements.

C Carefully perform demolition work, by skilled workers experienced in building demolition procedures, using appropriate tools and equipment. Perform work, at all times, under the direct supervision of a supervisor approved by the Owner Inspector.

D Coordinate demolition with other trades to ensure correct sequence, limits, and methods of proposed demolition. Schedule work to create least possible inconvenience to the public and to facility operations.

E Pre-Demolition: Conduct conference at Project site 7 days prior to scheduled installation.

1 Conference agenda shall include review and discussion of requirements of authorities having jurisdiction, instructions and requirements of serving utilities, sequencing and interface considerations and Project conditions.

2 Conference shall be attended by supervisory and quality control personnel of Contractor and all subcontractors performing this and directly related work. Submit minutes of meeting to Design Builder's Representative for Project record purposes.

1.3 DEFINITIONS

A Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

B Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to location as directed by Owner's Representative.

C Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

D Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Owner's Representative, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.

E Replace: Remove and legally dispose of existing item(s) indicated and install new like item(s) that conform to project specifications.

1.4 OWNERSHIP OF MATERIALS

A Ownership of Materials: Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

1.5 PROJECT CONDITIONS

A Drawings may not indicate in detail all demolition work to be carried out. Carefully examine existing conditions to determine full extent of demolition required. All utilities, whether shown on the drawings or not, to be capped at the property line U.N.O.

B Repair damage due to demolition activities to existing improvements to remain at no additional cost to the Owner. Repair or replace as directed by the Owner Inspector.

C Take measures to avoid excessive damage from inadequate or improper means and methods, or improper shoring, bracing or support. Repair or replace any resulting damage at no additional cost to the owner as directed by the Owner Inspector.

D If conditions are encountered that vary from those indicated, notify the Owner Inspector for instructions prior to proceeding. Owner assumes no responsibility for actual condition of structures to be demolished.

E Inform Owner immediately upon discovery of asbestos products, radioactive materials, toxic wastes or other hazardous materials. Do not remove hazardous materials without Owner authorization.

F Adjacent roadways/passageways:

- 1 Maintain fire department access through all phases of the project.
- 2 Obstruction of streets, walks or other adjacent facilities will not be allowed.

1.6 DIG ALERT NOTIFICATION

A Before any excavation in or near the public right-of-way, the Contractor must 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 you to hand expose to the point of no conflict 24" (inches) on either side of the underground facility, so you know its exact location before using power equipment.

F If caught digging without a Dig Alert ticket you can be fined as much as \$50,000 per California government code 4216.

PART 2-PRODUCTS

2.1 SOIL MATERIALS

A Satisfactory Soil Materials: Soils approved by the testing geotechnical engineer and free of rock or gravel larger than 4 inches in any dimension, debris, waste, vegetation and other deleterious matter and as approved by the Geotechnical Engineer. Rocks or hard lumps larger than approximately 3 inches in diameter should be broken into smaller pieces or should be removed from the site. It is anticipated that most of the on-site soils may be reusable as engineered fill after any vegetation, construction debris, oversized material and deleterious material is removed from the site. On-site soils shall be adequately moisture conditioned to permit achieving the required compaction.

B Backfill & Native Fill Materials: The on-site soils may be reused as compacted engineered fill provided they comply to the requirements of "Satisfactory Soil Materials", as described above.

C Borrow / Imported Fill Material: Soil excavated from site or imported conforming to requirements for fill material.

- 1 Materials for the fill shall be free from vegetable matter and other deleterious substances, shall not contain rocks or lumps of a greater dimension than is recommended by the geotechnical consultant, and shall be approved by the geotechnical consultant.

- 2 Imported materials shall confirm to soils report section 4.1.4 Fill Materials.

D Engineered Fill: Satisfactory Soil Materials / Borrow Fill Material, as described above, placed in lifts no greater than 6 inches thick (loose measurements) and each lift moisture conditioned per soils engineers recommendations. All engineered fill should be densified to a minimum relative compaction of 90 percent per ASTM D 1557.

E Backfill Material for Trenches:

- 1 The on-site soils may be used for backfilling utility trenches from six inches above the top of storm drain pipes to the surface, provided the material is free of organic matter and deleterious substances. Any soft and/or loose materials or fill encountered at pipe invert should be removed and replaced with properly compacted fill or adequate bedding material. Also, rocks larger than 3 inches and boulders should not be used as backfill.

2.2 HANDLING OF MATERIALS

A Items scheduled for salvage by the Owner shall be delivered to a location designated by the Owner's Authorized Representative. Items shall be cleaned, packaged and labeled for storage.

B Items scheduled for reuse shall be stored on site and protected from damage, soiling and theft.

PART 3-EXECUTION

3.1 GENERAL

A Protection:

- 1 Do not begin demolition until safety partitions, barricades, warning signs and other forms of protection are installed.
- 2 Provide safeguards, including warning signs, lights and barricades, for protection of occupants and the general public during demolition.
- 3 Provide and maintain fire extinguishers. Comply with requirements of governing authorities.
- 4 Maintain existing utilities which are to remain in service and protect from damage during operations.

B Safety: If at any time safety of existing construction appears to be endangered, take immediate measures to correct such conditions; cease operations and immediately notify the Owner Inspector. Do not resume demolition until directed by the Owner Inspector.

C Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances

D Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations. Do not create hazardous or objectionable conditions, such as flooding and pollution, when using water.

E Water for Dust Control: Contractor shall obtain and pay for all water required for his dust control operations. This may include, but is not limited to, payment of deposits to utility for construction meter, and payment of all monthly service and water charges. Construction meter shall be in place throughout construction period unless alternative arrangements are made with the Water Department to provide construction water for all purposes. Contractor shall be aware of water moratoriums and restrictions, and shall immediately advise Owner of effects on construction schedules.

F A 6 foot high, chain link fence and gates, shall be erected prior to any demolition operations at the construction limits perimeter. Coordinate the exact location with Owner.

G Debris Removal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

H Progress Cleaning: Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

I Where performing contracted scope of work requires coring of existing concrete, brick masonry, or CMU structures (including Walls, Floors, and Sitework), contractor shall obtain and document means of verifying existence and location of embedded steel reinforcing materials

within said concrete, brick and CMU assemblies. Contractor shall locate reinforcement by means of non-invasive technology such as X-ray photography for the purposes of protecting said reinforcement in place and shall not damage any reinforcement materials (rebar, etc.) unless specifically detailed as such and approved by the authority having jurisdiction.

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

K Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

L Contractor shall provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.

M Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.

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

O Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials if exposed, repaired surfaces shall match existing adjacent surface color finish and texture.

- 1 Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

P Disposal: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

3.2 PREPARATION

A Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.

B Utilities:

- 1 The Drawings do not purport to show all below-grade conditions and objects on the site. Contractor shall perform field investigations as necessary to establish location of underground utility services and other features affecting earthwork.
- 2 Mark location of underground utilities on asphalt pavement with paint
- 3 Disconnect and cap utility services; comply with requirement of governing authorities.

- 4 Contractor shall arrange and notify utility company in advance of date and time when service needs to be disconnected.
 - 5 Do not commence demolition operations until associated disconnections have been completed.
 - 6 Should utilities and other below-grade conditions be encountered which adversely affect the Work, discontinue affected Work and notify Owner's Representative and Architect and request direction. Unforeseen conditions will be resolved in accordance with provisions of the General Conditions of the Contract.
 - 7 Should a utility line or structure be damaged, immediately notify the responsible utility company or agency and notify Owner's Representative and Architect.
- C Repair or replace all damaged utility lines and structures as directed by the responsible utility company or agency.
- D Repair or replacement of damaged utility lines and structures whose location or existence has been made known to the Contractor shall be at no change in the Contract Time and Contract Price.
- E Structures to be demolished shall be inspected for hazardous materials. Such materials shall be removed and disposed of before general demolition begins.
- F Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner's Representative and Authority Having Jurisdiction (AHJ). Provide temporary services during interruptions to existing utilities, as acceptable to Owner's Representative and to Authority Having Jurisdiction (AHJ).

3.3 EXPLOSIVES

- A Explosives: Use of explosives will not be permitted.

3.4 DEMOLITION

- A Demolition, General:
- 1 With certain exceptions, the Contractor shall raze, remove and dispose of all buildings and foundations, structures, paving, fences and other obstructions that lie wholly or partially within the construction limits identified on Drawings. The exceptions are utility-owned equipment and any other items the Owner/Documents may direct the Contractor to leave intact or re-use onsite. Cease demolition immediately if adjacent structures appear to be in danger.
 - 2 Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 3 Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner's Representative and Authority Having Jurisdiction

(AHJ). Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

- 4 Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.
 - a Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - b Protect existing site improvements, appurtenances, and landscaping to remain.
 - c Completely remove below-grade construction, including foundation walls and footings.
- 5 Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings and pavements with soil materials according to requirements specified in Section 31 20 00: Earthwork.
- 6 Damages: Promptly repair damages to adjacent facilities caused by demolition operations.
- 7 Unless otherwise indicated on the plans, remove all demolished material from the site and dispose of at approved disposal sites. Comply with all requirements for recycling of demolished material as called for in Division 1 of this Specification. The contractor shall obtain necessary permits for the transportation of material from the site.

3.5 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

A Remove existing plumbing and electrical equipment fixtures and services not indicated for reuse and not necessary for completion of work. Remove abandoned lines and cap unused portions of existing lines. The Contractor is responsible for completely surveying the site and locating all existing utilities, above and below ground, before contracting to perform the work.

B Asbestos – Cement (A-C) Pipe Removal and Disposal: The plans for the project may indicate that existing asbestos-cement pipe is to be removed from the ground. Where so indicated the Contractor shall excavate with care, expose the pipeline and remove the A-C pipe to the nearest joint. Should the plans not call out the removal of the A-C pipe and A-C pipe is encountered, the Contractor shall obtain approval from the Owner as to whether or not the A-C pipe is to be removed or can be left in place. Cutting of the pipe shall only be done if absolutely there is no other way to expose the length of pipe to the nearest joint that be separated and the Owner approves the cutting of the pipe. Cutting of the pipe shall be done with a mechanical saw with a pressure water source to dampen the pipe and the dust from the cutting. To remove a coupling, the coupling may have to be broken in the trench. The pipe once removed from the trench may be broken for handling. The breaking shall be done within a plastic bagging or sheeting material to minimize the release of asbestos fibers into the atmosphere. Once removed and broken, if necessary, the A-C material shall be bagged and disposed of legally with the Owner to be given a copy of all Contractor paperwork as to the legal disposal of the material. If the A-C pipe section(s) are removed intact the pipe can be removed by the Contractor from the project site and become the property and responsibility of the Contractor.

3.6 CLEANING

- A Clean existing materials to remain, using appropriate tools and materials.
- B Protect adjacent materials and equipment during cleaning operations.

3.7 RESTORATION

- A Restoration of Site Finishes:
 - 1 Concrete paving: Where it is necessary to excavate a trench across make a cut in concrete paved areas, cut concrete cutting saw, full depth of paving.
 - 2 Bituminous paving: Where it is necessary to excavate a trench across make a cut in bituminous paved areas, either first score paving with a concrete cutting saw, in neat straight lines, prior to removing paving or make straight cuts with pneumatic spade.
 - 3 Restoration of paving: Restore all paved areas to their original condition using material of like type and quality as the removed paving. Paving in public ways shall conform to applicable requirements of authorities having jurisdiction. Repaired surfaces shall match existing adjacent paving except minimum depth shall be 3-1/2 inches where existing paving is less than 3-1/2 inches.
 - 4 Restoration of landscape planting: Restore soil and plant materials to match original condition, including additional topsoil, topsoil grading and preparation, new plant materials and plant maintenance during establishment period.

3.8 MAINTENANCE

- A Install and maintain all erosion control devices, including sandbag and gravel bag dikes, silt fences, de-silting basins, inlet barricades, vehicle wash traps, and other features called for in the Storm Water Pollution Prevention Plan and Temporary Erosion Control Plans.

3.9 CLEAN-UP/DISPOSAL

- A Coordinate building access with the Owner Inspector. Review and schedule waste storage and removal, include truck access to site.
- B Debris shall be dampened by fog water spray prior to transporting by truck.
- C Debris pick-up area shall be kept broom-clean and shall be washed daily with clean water.
- D Remove waste and debris, other than items to be salvaged. Turn over salvaged items to Owner, or store and protect for reuse where scheduled. Continuously clean-up and remove items as demolition work progresses. Do not allow waste and debris to accumulate in building or on site.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Forms for all cast-in-place concrete indicated on the Drawings and subsequent removal of forms, except those earth forms described in this Section.

1.02 RELATED SECTIONS

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

1.03 QUALITY ASSURANCE

- A. Qualifications of workmen: All workmen shall be experienced mechanics. Provide one person who shall be present at all time during execution of this portion of the work who shall be thoroughly familiar with the type of material being installed, the referenced standards and the requirement of this Work and shall direct all Work performed under this Section.
- B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Recommended Practice for Concrete Formwork," publication ACI 347R and ACI 318, Section 6.1.
- C. Where provisions of pertinent codes and standards conflict with the requirement of this Section, the more stringent provision shall govern.
- D. All Structural Concrete foundations, walls, floors, beams, roofs, columns, and any other structural component requiring structural forming or shoring shall be Engineer Designed Systems with calculations and erection drawings provided by the Contractor. Contractor is to secure the services of a California Registered Structural Engineer for the design of Forming Systems.

1.04 PRODUCT HANDLING

- A. Protection: Contractor is to protect all formwork materials before, during and after installation.
- B. Damaged Forms: In the event of damage or misalignment, immediately make all repairs and replacement necessary at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Form lumber: All form lumber shall be new except as allowed for re-use of forms in Part 3 of this Specification, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the Architect.
 - 1. Plywood forms may be Plyform, Plyron, and bearing the label of the Douglas Fir Plywood Association.

2. Form-lumber may be; fir, larch, hemlock, or approved equal seasoned lumber and surfaced on all four sides.
 3. Form sealers shall be liquid form oil.
- B. Pan Joist Concrete Forming and Shoring System: Forming and shoring for Concrete joist and slabs shall be an Engineered system. Contractor shall engage a Structural Engineer experienced in forming design for the type of construction shown on the drawings. Structural calculations and forming and shoring design erection drawings shall be provided.
- C. Other form materials and/or forming systems may be used if approved by the Owner, Architect and Structural Engineer. A complete list of materials, manufacturers and methods of application are to be submitted to the Architect, in accordance with Division 01.

2.02 TIES AND SPREADERS

- A. Form ties shall be of proven types and shall be a type which does not leave an open hole through the concrete and which permits patching at every hole.
- B. When forms are removed, all metal ties shall be removed and shall be flush with the concrete surface. No metal ties shall be exposed on the exterior of the walls.

2.03 ALTERNATE FORMING SYSTEMS

- A. Alternate forming systems may be used if approved by the Structural Engineer

2.04 OTHER MATERIALS

- A. All other form materials, not specifically described herein, but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to approval by the Owner or Architect.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor shall verify and be responsible for all-existing dimensions and elevations before any Work is done.
- B. Inspect the installed Work of all other trades; verify that all such Work is complete, and that the installation of Formwork may begin.
- C. Verify that forms have been constructed in accordance with all pertinent codes and regulations, referenced standards and the design.
- D. Discrepancies: Do not proceed with installation in areas of discrepancy. Notify the Architect of all discrepancies. All discrepancies are to be fully resolved before proceeding with installation.

3.02 CONSTRUCTION FORMS

- A. Forms are to be constructed sufficiently tight to prevent leakage of concrete, and able to withstand excessive deflection when filled with wet concrete. Forms shall be braced, anchored and properly aligned.
- B. Layout and form all required cast-in-place concrete to the required dimensions indicated on the Drawings.

- C. Care shall be exercised in the layout of forms to avoid the necessity for cutting, patching, or repair of concrete after it is in place.
- D. Make provisions for all openings, offsets, recesses, anchorage, blocking and other requirements of the Work.
- E. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installations.
- F. Carefully examine the Drawing and Specifications and verify with other trades for openings, reglets, chases, and other items that are required in the forms.
- G. Forms for pre-cast concrete shall be constructed to provide for shrinkage of the concrete, and shall be adequately braced. All edges shall have chamfer strips except as noted on Drawings.
- H. Construct all forms true, plumb, and square within a tolerance of 1/8" in 12 feet.

3.03 EMBEDDED ITEMS

- A. Provide, install and check all required steel frames, angles, grilles, bolts, inserts and other such items required to be anchored in the forms before the concrete is placed.

3.04 BRACING

- A. Properly brace and tie the forms together so as to maintain size, shape, and alignment, and to provide safety to personnel.
- B. Construct all bracing and supporting members of ample size and strength to safely support, without excessive deflection, all dead and live loads to which they may be subjected.

3.05 PLYWOOD FORMS

- A. Plywood forms shall be designed for loads imposed. Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
- B. Make all panel joints tight butt joints with all edges true and square, if necessary, use tape to prevent excessive leakage.

3.06 FOOTING FORMS

- A. Foundation forms are to be wood forms.
- B. Earth forms may be used for footings provided the soil will stand without caving, as determined by the Architect (Structural Engineer) and the sides of the bank are made with a neat cut to the minimum dimensions indicated.

3.07 REUSE OF FORMS

- A. Reuse of forms shall be subject to approval of the I.O.R.
- B. Reuse of forms shall not delay or change the schedule for placement of concrete from the schedule if all forms were new.
- C. Reuse of forms shall not affect the structural stability of the forms or the appearance of the finished concrete.

3.08 REMOVAL OF FORMS

- A. Side forms of foundations may be removed 48 hours after placement of concrete. Where foundations are supporting lateral loads, forms shall not be removed until approved by the I.O.R.
- B. Use care and diligence, and protect workmen, passers-by, and the installed work and materials of other trades. Forms shall not be removed until the concrete can support all loads.
- C. Cut nails, tie wires and form ties off flush, leave all surfaces smooth and clean.
- D. Remove metal spreader ties and fill in the resulting pockets to match the surrounding areas with grout or dry pack. Sack all exposed faces.
- E. Fill all holes resulting from the use of bolts, ties, spreaders and sleeve nuts with cement grout applied under pressure by means of a grouting gun; grout shall be one part Portland cement, to two parts sand; apply grout immediately after removing forms.

3.09 CLEANING

- A. Remove all forming material from the site and dispose of in approved dumps.
- B. Clean area of all left over debris including stakes, ties, form boards, wires, concrete spills, etc., and leave area in a neat clean condition.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete steel reinforcement as indicated.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.

1.02 SYSTEM DESCRIPTION

- A. Regulatory Requirements: Fabrication and placement of reinforcing shall be in accordance with requirements of CBC, Chapter 19A.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
 - 2. American Welding Society (AWS).
 - 3. American Concrete Institute (ACI).
 - 4. CBC, Chapter 19A, Concrete.
- B. Source Quality Control: Refer to Division 01 Sections for general requirements and to following paragraphs for specific procedures. Testing laboratory retained by the Owner shall perform following conformance testing, select test Samples of bars, ties, and stirrups from the material at the Project site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A 615.
 - 1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.
 - 2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained, perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.

- C. Certification of Welders: Shop and Project site welding shall be performed by certified welding operators.

1.05 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.01 GENERAL

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

2.02 MATERIALS

- A. Steel Reinforcing Bars: ASTM A 615 and A 706 for welding, grade 60 billet steel unless otherwise specified or indicated.
- B. Bars or Rod Mats: ASTM A 184.
- C. Wire Fabric for Reinforcement: ASTM A 1064.
- D. Tie Wire: ASTM A 82, fully annealed, copper-bearing steel wire, 16 gage minimum.
- E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI-315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.03 FABRICATION OF REINFORCING BARS

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.
- C. Welding: Provide only ASTM A 706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

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

3.02 CLEAN UP

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

3.03 PROTECTION

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

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete placement and finishing.
 - 2. Related Sections:
 - a. Section 03 10 00 - Concrete Forming and Accessories.
 - b. Section 03 20 00 - Concrete Reinforcing.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.
- B. Product Data:
 - 1. Mix Design: Submit a concrete mix design for each mix that will be provided for the Work. Include water/ cement ratio, size of coarse aggregate and amount of any admixture. Predict minimum compressive strength, maximum slump and air content percentage.
 - 2. Manufacturer of ready-mixed concrete shall deliver to the job for a certificate with each mixer truck. Certificate shall bear the signature of representative of the testing laboratory, and shall state quantity of cement, water, fine and coarse aggregate and admixtures.
- C. Material Samples: Submit Samples illustrating concrete finishes, minimum 12 inches x 12 inches in size.
- D. Certificates: Submit a notarized certificate that each of following conforms to standards indicated:
 - 1. Aggregates - ASTM Standards C33
 - 2. Admixtures - ASTM Standards C260
 - 3. Curing materials - ASTM Standards C171

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement.
- B. American Concrete Institute (ACI) Publication:
 - 1. ACI 211 - Recommended Practice for Selecting Proportions of Concrete.
 - 2. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
 - 3. ACI 305 - Recommended Practice for Hot Weather Concreting.
 - 4. ACI 306 - Recommended Practice for Cold Weather Concreting.

5. ACI 308 - Recommended Practice for Curing Concrete.
 6. ACI 309 - Recommended Practice for Consolidation of Concrete.
- C. American Society for Testing and Materials (ASTM) Standards:
1. ASTM A 1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 2. ASTM C 31 - Making and Curing Concrete Test Specimens in the Field.
 3. ASTM C 33 - Concrete Aggregates.
 4. ASTM C 39 - Compressive Strength of Cylindrical Concrete Specimens.
 5. ASTM C 88 - Soundness of Aggregates by use of Sulphate or Magnesium Sulphate.
 6. ASTM C 94 - Ready-Mixed Concrete.
 7. ASTM C 143 - Slump of Hydraulic Cement Concrete.
 8. ASTM C 150 - Portland Cement.
 9. ASTM C 171 - Sheet Materials for Curing Concrete.
 10. ASTM C 172 - Sampling Freshly Mixed Concrete.
 11. ASTM C 173 - Air Content of Freshly Mixed Concrete by the Volumetric Method.
 12. ASTM C 227 - Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
 13. ASTM C 231 - Air Content of Freshly Mixed Concrete by the Pressure Method.
 14. ASTM C 260 - Air-Entraining Admixtures for Concrete.
 15. ASTM C 289 - Potential Reactivity of Aggregates (Chemical Method).
 16. ASTM D 1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- D. Continuous inspection shall be provided at the batch plant and for transit-mixed concrete to run check sieve analysis of aggregate, check moisture content of fine aggregate, check design of mix, check cement being used with test reports, check loading of mixer trucks, and certify to quantities of materials placed in each mixer truck.
- E. Inspection shall be performed by a representative of a testing laboratory selected by the Owner. Owner will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.
- F. Continuous batch plant inspection requirement may be waived in accordance with CBC Section 1929A. 5. Waiver shall be in writing, including DSA approval.
- G. Strength Test of Concrete: Refer to Section 01 45 00 – Quality Control.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Mixing and Placing Concrete: Refer to Section 01 45 00 – Quality Control.
- B. Ready-mix concrete shall be mixed and delivered in accordance with ASTM C 94 and CBC Standard 19-3 and 19-4. Each batch of concrete delivered to the Project site shall be accompanied by a time slip bearing departure time and signature of batch plant supervisor. Concrete shall be placed within 90 minutes after start of mixing.

- C. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.

1.05 JOB CONDITIONS

A. Cold Weather Requirements:

- 1. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Surfaces, in which concrete is to come in contact with, shall be free from frost or ice. No frozen materials or materials containing ice shall be furnished.
- 2. When placing concrete during freezing or near-freezing weather the mix shall have a temperature of at least 50 degrees F., but not more than 90 degrees F. when cement is added. Concrete shall be maintained at a temperature of at least 50 degrees F. for at least 72 hours after placing or until it has thoroughly hydrated. When necessary, concrete materials shall be heated before mixing. Special precautions shall be provided for protection of transit-mixed concrete.

B. Hot Weather Requirements:

- 1. During hot weather, proper attention shall be provided for ingredients, production methods, handling, placing, protection and curing, to prevent excessive concrete temperatures or water evaporation which could impair required strength or durability.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of CBC Chapter 1905A.
- B. Strength of Concrete: Concrete, unless otherwise indicated or specified, shall be provided with a minimum ultimate 28-day strength of 3000 psi (f'c). For high-early-strength concrete, age for reaching the f'c shall be as indicated on Drawings.

2.02 MATERIALS

- A. Cement: ASTM C 150 Type II Portland Cement. Furnished cement shall be as selected and reviewed for concrete proportioning.
- B. Aggregates: Aggregates shall conform to ASTM C 33 and C 227 except as modified herein. Any suitable individual grading of coarse aggregate may be furnished, provided Grading of Combined Aggregate indicated in following table is obtained. Refer to Section 01 45 23: Testing and Inspection.

GRADING OF COMBINED
AGGREGATE

Sieve Number or Size in inches	1-1/2"	1"	3/4"
	Maximum	Maximum	Maximum
Passing a 2"	-----	-----	-----
Passing a 1-1/2"	95-100	-----	-----
Passing a 1"	70-90	90-100	-----
Passing a 3/4"	50-80	70-95	90-100

Passing a 3/8"	40-60	45-70	55-75
Passing a No. 4	35-55	35-55	40-60
Passing a No. 8	25-40	27-45	30-46
Passing a No. 16	16-34	20-38	23-40
Passing a No. 30	12-25	12-27	13-28
Passing a No. 50	2-12	5-15	5-15
Passing a No. 100	0-3	0-5	0-5

- C. Water: Water shall be potable and free from deleterious matter.
- D. Admixtures: CBC Chapter 19A, Section 1903A.6, Type A or D.
- E. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D 1751.
- F. Curing Paper and Liquid Curing Compounds:
 - 1. Curing Paper: A standard brand conforming to ASTM C 171, Type 1 - Regular, Kure-N-Seal.
 - 2. Liquid Curing Compounds: A standard brand, clear liquid conforming to ASTM C 309, Master Builders, Grace, Antihydro.
- G. Abrasive Aggregate: Norton Alundum, Union Carbide Carborundum, or equal, graded #12 through #30 sizes, color as selected by Architect.
- H. Underlayment: Latex underlayment for filling low spots in concrete shall be Tile-Tex by Flintkote Co., Webtex #60 or Fixallatex by Dowman Products Co.
- I. Vapor Retarder: See Section 07 26 16 - Under-Slab Vapor Retarder.
- J. Stair Strips and Nosing:
 - 1. Fabricated from 6063-T5 extruded aluminum, mill finish. Anti-slip filler shall contain at least 60 percent virgin grain aluminum oxide abrasive. Binder shall be fully cured resilient type epoxy, with binder-to-filler ratio of 13 percent. The epoxy-abrasive filler shall extend over the curved front edge of the nosing and shall be securely bonded to the extruded aluminum base.
 - 2. Manufactured by Wooster Products Inc. American Safety Tread Co. Inc., or equal.
 - 3. Nosing and strips for concrete casting shall be provided with Sure-Hold anchors, chevron shaped continuous full length of nosing or strip.
 - 4. Nosings and anchors for attachment to hydrated concrete stairs and wood stairs shall be similar to those specified below, except they shall be provided with countersunk holes for screws and fasteners.
 - 5. Colors: As selected by Architect to contrast with stair color. Colors shall extend uniformly through the filler.
 - 6. Strip and Nosing Types:
 - a. Nosings for sloped riser steel pan stairs: Type WP4J, 4-1/16 inches wide, 3/8 inch thick.
 - b. Nosings for new concrete stairs: Type WP4C, 4-1/16 inches wide, 3/8 inch thick, nose projects down 1/4 inch.

- c. Nosings for square edged steel pan stairs: Type WP4SP, 4-1/16 inches wide, 3/8 inch thick nose.
- d. Strips for recessing into concrete stairs: Type WP1A, except 2-1/4 inches wide, 3/8 inch thick. American Safety Tread Co., Type 24, or equal.
- e. Strips for adhering to existing or hydrated concrete: Flex-Tred anti-safety strips, minimum 2-1/4 inches wide. Cut from rolls and round corners.
- f. Strips for anchoring into wood or stone: American Safety Tread Co., Type 24H, or equal, with holes for fasteners, 2-1/4 inches wide.

PART 3 - EXECUTION

3.01 GENERAL

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

3.02 PREPARATION

- A. Vapor Retarder: See Section 07 26 16 - Under-Slab Vapor Retarder.
- B. Reglets and Rebates:
 - 1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
 - 2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.
- C. Anchor Slots: Dove-tail anchor slots at concrete walls to receive masonry veneer shall be set vertically in forms, 24 inches maximum on centers measured horizontally. Anchor slots shall be No. 24 gage galvanized sheet steel with removable fiber filler to prevent seepage of cement in slot.
- D. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

3.03 INSTALLATION

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

2. Concrete shall be conveyed from mixer to location of final placement by methods, which will prevent separation or loss of materials.
 3. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete which has been remixed after initial set be placed.
 4. In placing concrete in thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.
 5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
 6. Concrete shall be thoroughly consolidated during placement, and shall be worked around reinforcement and embedded fixtures with mechanical vibrators.
 7. Where conditions make consolidation difficult, or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.
- B. Compaction and Screeding:
1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.
 2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.
- C. Floating and Troweling:
1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.
 2. For interior finish slabs, final troweling shall provide a hard, impervious, and non-slip surfaces, free from defects and blemishes. Finished surface shall be within a tolerance of 1/8 inch in 10 feet. Avoid burnishing. Do not add cement or sand to absorb excess moisture.
 3. Exterior Paving and Cement Walks: Finish as specified above, except surface shall be given a non-slip broom finish to match Sample reviewed by the Architect.
 4. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.
- D. Curing:

1. Concrete shall be maintained above 50 degrees F., and in a moist condition for 7 days after placing, except that high early strength concrete shall be maintained in a moist condition for 3 days.
 2. Before applying curing paper, interior floor treated with colored hardener shall be given a heavy protective coat of colored wax left unpolished, and then immediately covered with paper. If wax is not applied within two hours after final troweling, concrete shall be sprayed with a fine water mist and maintained continuously moist until wax is applied, unless spraying is not recommended by hardener manufacturer. After other Work such as plastering and painting has been completed, curing paper shall be removed and waxed floors cleaned of protective wax coating.
 3. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.
 4. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.
 5. Immediately after finishing, roof slabs and monolithic floor finish to receive resilient floor covering shall be uniformly and completely coated with liquid curing compound.
 - a. Install compound in a manner and quantity sufficient to produce a uniform continuous thin film of water-impervious membrane. Compound shall be installed in accordance with manufacturer's directions.
 - b. Protect adjoining surfaces from damage during installation. If curing compound is not applied immediately, cover finished concrete with wet burlap or curing paper and keep concrete surface wet for a period not to exceed thirty hours following finishing of concrete. At end of that time, burlap or paper shall be removed and curing compound installed as specified above.
 - c. Immediately after finishing, monolithic floor slabs not scheduled to receive resilient floor covering shall be covered with curing paper. Paper shall be lapped 3 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.
 - d. Within 24 hours after finishing, exterior slabs and paving, and interior slabs to receive cement topping or mortar setting beds, shall be covered with sand to a depth of 2 inches and kept thoroughly wet for 7 days.
 - 1) Instead of sand covering, exterior walks and paving where no other surface treatment is specified, may be cured with clear liquid curing compound immediately installed in accordance with manufacturer's directions.
- E. Filling, Leveling and Patching:
1. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.

2. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.
- F. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.04 FINISHING

- A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.
- B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.
1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.
 2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.
- C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand-blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.
- D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish. Abrasive grains in amount of 30 pounds per 100 square feet shall be evenly installed by dust-on method and embedded into surface during first troweling operation. Additional abrasive grains, in amount of 30 pounds per 100 square feet, shall then be evenly installed and embedded into surface during final troweling operation.
- E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener, as specified. Install hardener after surface of concrete has reached the point where no excess moisture is present, but while it is still plastic. Hardener shall be installed as follows:
1. Colored Hardener: Install at rate of 40 pounds per 100 square feet of surface for initial application.
 2. Gray (natural) Hardener: Install at rate of 20 pounds per 100 square feet of surface for initial application.
 3. Hardener shall be evenly distributed and thoroughly floated into surface mortar with a wood float. An additional 20 pounds of hardener, colored or gray, specified as above,

shall be installed over each 100 square feet, and troweled to an even surface having uniform color and texture.

- F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.
- G. Broom Finish: Exterior stair treads and landings shall be provided with a non-slip broom finish in addition to abrasive finish specified.
- H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturers written recommendations.

3.05 EXPANSION AND CONSTRUCTION JOINTS

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

3.06 TESTING

- A. Molded Cylinder Tests:
 - 1. Owner Consultant will prepare cylinders. Each cylinder shall be dated, given a number, point in structure from which sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.
 - 2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of 3 days, 7 days, and 28 days. A strength test shall be the average of the compressive strength of 2 cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'c.

3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C 31, and tested in accordance with ASTM C 39.
- B. Core Test: At request of the Architect, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC and ASTM C 42.
1. Provide 4 inch diameter cores at representative places throughout the structure as designated by the Architect.
 2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.
 3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.
- C. Concrete Consistency: Measure consistency according to ASTM C 143. Test twice each day or partial day's run of the mixer.
- D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, fall below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.
- E. Defective Concrete:
1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the Architect and DSA.
 2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to intended grades and levels, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.
- F. Concrete for Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall be 3,000 psi concrete. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 03 10 00: Concrete Forms and Accessories, and reinforced as described in Section 03 20 00: Concrete Reinforcement. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4 inch to 1 inch aggregate as specified for concrete mix.

3.07 CLEAN UP

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

3.08 PROTECTION

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

END OF SECTION

SECTION 03 35 11
CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.

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 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.
- B. 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.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- D. 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.

1.05 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: 6 feet square.
 - 1. Demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
- C. Locate where directed.
- D. Acceptable mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.07 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.

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 Physically Disabled: Provide flooring meeting slip-resistant requirements of California Code of Regulations (CCR), Title 24, Part 2, Chapter 11B and ADA Accessibility Guidelines for Buildings and Facilities, latest amendment.
 - 1. Flooring demonstrating a coefficient of friction of at least wet SCOF 0.6 per ASTM C1028 will be accepted as meeting the intent of slip resistance; CBC 11B-302 Floor or Ground Surfaces, 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.
 - 2. Flooring surface shall be stable, firm, and slip resistant. CBC Section 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 11B-302 Floor or Ground Surfaces and ADA Standards.
 - a. Ramp surface: Provide DCOF value of 0.46 wet.

2.02 CONCRETE FLOOR FINISH APPLICATIONS

- A. Unless otherwise indicated, all concrete floors are to be finished using high gloss sealer.
- B. Liquid Densifier/Hardener:
 - 1. Use at following locations: concrete floors on grade.
- C. Penetrating Clear Sealer:
 - 1. Use at following locations: CF-2.
- D. High Gloss Clear Sealer:
 - 1. Use at following locations: CF-1.

2.03 DENSIFIERS AND HARDENERS

- A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 - 1. Composition: Lithium silicate.
 - 2. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.

3. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
4. Hardening: As follows when tested in accordance with ASTM C39:
 - a. After 7 Days: An increase of at least 40% over untreated samples.
 - b. After 28 Days: An increase of at least 38% over untreated samples.
5. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C1028.
6. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
7. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.
8. Products:
 - a. Dayton Superior Corporation; Pentra-Hard® Densifier: www.daytonsuperior.com/#sle.
 - b. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; SEAL HARD: www.lmcc.com/#sle.
 - c. Nox-Crete Products Group; Duro-Nox: www.nox-crete.com/#sle.
 - d. SpecChem, LLC; Cure Hard: www.specchemllc.com/#sle.
 - e. Euclid Chemical Corporation; Eucosil: www.euclidchemical.com.
 - f. Paul M. Wolff Co.; SHUR-HARD: www.paulwolffco.com.
 - g. W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com/#sle.
 - h. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.04 COATINGS

- A. High Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
 1. Composition: Acrylic polymer-based.
 2. Nonvolatile Content: 15 percent, minimum, when measured by volume.
 3. Products:
 - a. Basis of Design Product: E100-UV1™ Clear Epoxy as manufactured by Elite Crete Systems, or approved equal.
 - b. Butterfield Color; Clear Guard H2O Water-Based Wet Look: www.butterfieldcolor.com.
 - c. Dayton Superior Corporation; PENTRA-HARD® GUARD: www.daytonsuperior.com/#sle.
 - d. Euclid Chemical Company; ULTRAGUARD: www.euclidchemical.com/#sle.
 - e. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.: www.lmcc.com.
 - f. L.M. Scofield Company; SCOFIELD® Cureseal-VOC™: www.scofield.com.
 - g. The QUIKRETE Companies: www.quikrete.com/#sle.
 - h. SpecChem, LLC; Aqua Shine: www.specchemllc.com/#sle.
 - i. W. R. Meadows, Inc; Decra-Seal W/B: www.wrmeadows.com/#sle.
 - j. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

- B. Epoxy Sealer: Non-yellowing, VOC compliant coating.
 - 1. Color: Color to be selected by Architect from manufacturer's standard colors
 - 2. Composition: Single or Two-Component 100% Solids with slip resistant aggregate.
 - 3. USDA Approval: Yes
 - 4. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com.
 - b. Euclid Chemical Corporation; Duraltex: www.euclidchemical.com.
 - c. Monochem Inc.; Epoxyguard 100: www.paulwolffco.com.
 - d. Paul M. Wolff Co.; Epox-O-Sheen: www.paulwolffco.com.
 - e. W.R. Meadows, Inc; Decra-Seal W/B: www.wrmeadows.com.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Plastic Aggregate: Finely ground polymer for addition to coatings for slip resistance.
 - 1. Products:
 - a. Dayton Superior Corporation; Grip Aid: www.daytonsuperior.com/#sle.
 - b. SpecChem, LLC; Surface Grip: www.specchemllc.com/#sle.
 - c. W. R. Meadows, Inc; Sure-Step: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.05 JOINT FILLER

- A. Two component, semi-rigid, epoxy joint filler with minimum compressive strength at 72 hours of 3000 psi per ASTM D 695, minimum elongation of 55% per ASTM D 638, and minimum Shore A Hardness of 100 per ASTM D 2240.
- B. Color(s): As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
 - 1. Concrete substrate shall be structurally sound.
- B. Concrete shall be minimum 28 days old.
- C. 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 JOINT FILLER APPLICATION

- A. All joint facings shall possess an open surface texture. Run a saw blade or grinder down each side of the joint to expose fresh concrete.
- B. Do not use backer rod, sand, or other fill material. Joint filler shall be full depth. A very thin sand layer is acceptable to help prevent the joint filler from flowing into the substrate.
- C. Blow joints clean using un-oiled air.
- D. Prepare joint filler per manufacturer's recommendations.
- E. Fill to 2/3 of the full depth of the joint.
- F. Allow the joint filler to settle and then within 1 hour complete the filling and slightly overfill the joint.
- G. Within 24 hours cut flush with a razor knife or grind flush.

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 PROTECTION

- A. Prevent trades from walking and driving through uncured Joint Filler.

END OF SECTION

SECTION 04 05 11
MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 00 - Unit Masonry: Installation of mortar and grout.

1.03 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.
- D. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- E. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2015.
- F. ASTM C476 - Standard Specification for Grout for Masonry; 2016.
- G. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2015a.
- H. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- I. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2016.
- J. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry; 1995 (Reapproved 2013).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
- D. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each document on project site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.07 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or CBC Chapter 21A building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

- A. Use only factory premixed packaged dry materials for mortar and grout, with addition of water only at project site.
 - 1. Exception: If a specified mix design is not available in a premixed dry package, provide equivalent mix design using standard non-premixed materials.
- B. Mortar Color: Natural gray unless otherwise indicated.
- C. Mortar Mix Designs: ASTM C270, Proportion Specification, Type S.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior, Non-loadbearing Masonry: Type S.
 - 3. Interior, Loadbearing Masonry: Type S.
- D. Grout Mix Designs:
 - 1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
 - a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
 - b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 2. Engineered Masonry: Compressive strength at 28 days: as indicated on Drawings; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
 - a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
 - b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.02 MATERIALS

- A. All materials to conform to CBC, Section 2103A.2 and 2103A.3.
- B. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Type: Type S.

2. Color: Standard gray.
- C. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
 1. Type: Fine.
- D. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
- E. Water: Clean and potable.
- F. Bonding Agent: Latex type.

2.03 MORTAR MIXING

- A. Ready Mixed Mortar: ASTM C1142, Type equivalent to that specified according to ASTM C270.
- B. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- C. Maintain sand uniformly damp immediately before the mixing process.
- D. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
- E. Do not use anti-freeze compounds to lower the freezing point of mortar.
- F. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
 1. Basis of Design Product: Grout Aid as manufactured by Sika, or approved equal.
 2. Admixtures shall meet the requirements of CBC Section 2103A.5 and have an evaluation report meeting the requirements of IR A-5.
 3. The approval of the Architect or structural engineer and DSA is required for the use of any admixture.

PART 3 EXECUTION

3.01 PREPARATION

- A. Apply bonding agent to existing concrete surfaces.
- B. Plug clean-out holes for grouted masonry with block masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.

- B. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

3.03 GROUTING

- A. Use either low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.
- B. Low-Lift Grouting:
 - 1. Limit height of pours to 48 inches.
 - 2. Limit height of masonry to 16 inches above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. When grouting is stopped for more than one hour, terminate grout minimum 1-1/2 inch, 2 inches maximum below top of upper masonry unit to form a positive key for subsequent grout placement.
- D. Solid grout all cells and courses, no exceptions. Consolidate with 3/4 inch diameter mechanical vibrator inserted into each and every cell.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 45 00 - Quality Control.
- B. Testing of mortar and grout: Conform to the requirements of CBC, Section 2105A.3.
- C. Test and evaluate mortar in accordance with ASTM C780 procedures.
 - 1. Test with same frequency as specified for masonry units.
- D. Test and evaluate grout in accordance with ASTM C1019 procedures.
 - 1. Test with same frequency as specified for masonry units.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clay facing brick.
- B. Reinforcement and anchorage.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 04 05 11 - Mortar and Masonry Grout.
- C. Section 05 50 00 - Metal Fabrications: fabricated steel items.
- D. Section 07 25 00 - Weather Barriers: Water-resistive barriers or air barriers applied to the exterior face of the backing sheathing or masonry.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- F. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- E. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2018.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- F. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016.
 - 1. Use 2014 as indicated in 2016 CBC Referenced Standards.
- G. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2016.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- I. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.
- J. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- K. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.

- L. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2005.
- M. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- N. DSA, Interpretation of Regulations Document IR 21-2.13 - Concrete Masonry High Lift Grouting Method; 3/03/16.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for masonry units and masonry accessories.
- C. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- F. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of AHRI 210/240, except where exceeded by requirements of the contract documents.
 - 1. Maintain one copy of each document on project site.
- B. Regulatory Requirements: Except as modified by the requirements specified herein or the details indicated, reinforced concrete unit masonry construction shall conform to the California Building Code (CBC), Title 24, Part 2, Chapter 21A - Masonry.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
 - 1. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes,

contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

PART 2 PRODUCTS

2.01 BRICK UNITS

- A. Basis of Design Product: Custom Norman Brick as manufactured by Endicott Clay Products Co., or approved equal.
- B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
 - 1. Color and texture: To match existing.
 - 2. Custom sculptural shape as indicated on Drawings. Image to be provided by Campus through the Architect.
 - 3. Nominal size: 2-1/4 H by 11-5/8 W by 3-5/8 D inches.
 - 4. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
 - 5. Compressive strength: As indicated on drawings, measured in accordance with ASTM C67/C67M.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 05 11.
- B. Grout Aggregate: ASTM C 404 pea gravel except graded with not more than 5 percent passing the No. 8 sieve and 100 percent passing 3/8-inch sieve size.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Basis of Design Product: HFA Fleming Anchor System as manufactured by Halfen; www.halfen.com, or approved equal.
- B. Manufacturers:
 - 1. Blok-Lok Limited: www.blok-lok.com/#sle.
 - 2. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - 3. WIRE-BOND www.wirebond.com/#sle.
- C. Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on drawings; uncoated finish.
- D. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 1-1/2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M, Class B.
- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 - 1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- F. Masonry Veneer Anchors: As indicated on Drawings, between masonry veneer and structural backup, mill galvanized.

1. Anchor Channels: 1 x 21/32 inch with inturned lips roll formed from 22 gage, 0.033 inch steel strip.
 - a. Mounting Hole Spacing: Prepunched 12 inches on center.
2. T-Shaped (Fleming) Anchors: 14 gage, 0.075 inch thick steel strip, with central stiffening rib and two tabs
 - a. Length: 2-1/8 inch, 3-1/8 inch, 4-1/8 inch, and 5-1/8 inch.
3. Masonry Veneer Horizontal Reinforcement: Wire type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; W1.7 (9 gage), 0.1483 inch.
4. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.

2.04 FLASHINGS

- A. Metal Flashing Materials:
 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.
- B. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
- C. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.
- D. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.05 ACCESSORIES

- A. Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, fused joints.
 1. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com/#sle.
 - b. Dur-O-Wal: www.dur-o-wal.com.
 - c. Hohmann & Barnard, Inc: www.h-b.com.
 - d. WIRE-BOND: www.wirebond.com/#sle.
 - e. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self expanding; 3/8 inch wide by maximum lengths available.
 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Weeps:
 1. Type: Polyethylene tubing.
 2. Color(s): As selected by Architect from manufacturer's full range.

- a. Manufacturers:
 - 1) Advanced Building Products, Inc: www.advancedbuildingproducts.com/#sle.
 - 2) Blok-Lok Limited: www.blok-lok.com.
 - 3) Hohmann & Barnard, Inc: www.h-b.com.
 - 4) Mortar Net Solutions: www.mortarnet.com/#sle.
 - 5) WIRE-BOND: www.wirebond.com.
 - 6) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Cavity Vents:
 - 1. Type: Molded PVC grilles, insect resistant.
 - 2. Color(s): As selected by Architect from manufacturer's full range.
 - a. Manufacturers:
 - 1) Advanced Building Products, Inc: www.advancedbuildingproducts.com/#sle.
 - 2) Blok-Lok Limited: www.blok-lok.com.
 - 3) Hohmann & Barnard, Inc: www.h-b.com.
 - 4) Mortar Net Solutions: www.mortarnet.com/#sle.
 - 5) WIRE-BOND: www.wirebond.com.
 - 6) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
 - 1. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2-cup dry measure) and laundry detergent (1/2-cup dry measure) dissolved in one gallon of water.
 - 2. Basis of Design Product: Enviro Klean as manufactured by ProSoCo, Inc., www.prosoco.com, or equal.
 - 3. Pre-Faced Units: Basis of Design Product: Custom Burnished Masonry Cleaner as manufactured by ProSoCo, Inc., www.prosoco.com, or equal.
 - a. Dilute 1 part to 3 parts clean water.
 - b. Do not powerwash.
- F. Proprietary Acidic Cleaners: Standard-strength cleaners designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below.
 - 1. Do not discolor or damage masonry surfaces.
 - 2. Cleaners shall be expressly approved for intended use by manufacturer of masonry units being cleaned.
 - 3. Comply with applicable occupational safety and hazardous and toxic materials regulations in handling and disposing of solutions.
 - 4. General Purpose Cleaner: For removal and control of efflorescence, removal of excess mortar, grout and common construction soiling from new masonry not subject to metallic oxidation stains.
 - a. Basis of Design Product: Sure Klean No. 600 as manufactured by ProSoCo, Inc., www.prosoco.com, or equal.
 - 5. Cleaner for Asphalt and Tar: For removing asphalt, tar, grease, hydraulic oil, motor oil and similar materials from porous masonry.

- a. Basis of Design Product: Sure Klean Asphalt & Tar Remover as manufactured by ProSoCo, Inc., www.prosoco.com, or equal.
- 6. Cleaner for Lime Putty Stains: For removing excess mortar, heavy lime deposits and normal construction stains from new masonry surfaces where high-strength lime putty mortar mixes have been used.
 - a. Basis of Design Product: Sure Klean 101 Lime Solvent as manufactured by ProSoCo, Inc., www.prosoco.com, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Comply with CBC Section 2104A in addition to referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.
- C. Cut or trim interior of face shells or cross webs of masonry units, where necessary, to provide a minimum clearance of 1/2 inch or one bar diameter, whichever is greater, to reinforcing bars.
- D. Protection of Unit Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each workday. Cover partially completed unit masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24-inches down both sides and hold cover securely in place.
- E. Stain Prevention: Prevent grout, mortar, and soil from staining the face of unit masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that come in contact with such masonry.
- F. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond; do not tooth. Clean exposed surfaces of set masonry, and remove loose masonry units and mortar prior to laying fresh masonry.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of AHRI 210/240 or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Veneer Units:

1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches, vertical.
3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
 1. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 2. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- C. Lay hollow masonry units with face shell bedding on head and bed joints.
- D. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- E. Remove excess mortar and mortar smears as work progresses.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools (motor-driven saws) to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Use full-size units without cutting where possible.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
- L. Provide smooth finished (e.g. precision) masonry units behind light fixtures, accessories or other flush fitting wall mounted equipment.
 1. Place the mounting of such equipment anchors on the center one-half of the closest block.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

- A. Place continuous joint reinforcement in first and second joint below top of walls.

- B. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- C. Lap joint reinforcement ends as indicated on Drawings, minimum 6 inches.
- D. Reinforce joint corners and intersections with strap anchors 16 inches on center.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.

3.08 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Stud Back-Up: Secure veneer anchor channels to stud framed back-up at 12 inches on center vertically and place at maximum 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
 - 1. Secure the channels to the metal studs with No. 10, 0.189 inch corrosion resistant Teks screws (or equal).
- B. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.
 - 1. Place the wire reinforcement in the middle 1/3 of brick width.
 - 2. After the first 2 or 3 courses of masonry have been laid, install the foot end of the anchors into the channel.
 - 3. T-anchor Vertical Spacing: 12 inches maximum.
 - 4. Galvanized wire reinforcement is then placed behind the tabs on the anchors.
 - 5. Reinforcement at Joints: Overlap 6 inches minimum.

3.09 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
 - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
- D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- E. Extend plastic, laminated, and EPDM flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

- F. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.10 CONTROL AND EXPANSION JOINTS

- A. Control Joints: As indicated on Drawings.
- B. Control Joints: Locate control joints maximum 24 feet on center or as indicated. If not shown, provide submittal to Architect with proposed locations for approval.
- C. Expansion Joints: As indicated on Drawings.
- D. Do not continue horizontal joint reinforcement through control or expansion joints.
- E. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- F. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
- G. Comply with Section 07 92 00 for sealant performance.
- H. Form expansion joint as detailed on drawings.

3.11 BUILT-IN WORK

- A. As work progresses, install built-in fabricated metal frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Verify tolerances prior to placing next course. If the unit placed does not meet the tolerances listed below, it shall be removed and reinstalled to meet specified tolerances at no additional cost to District.
- C. Maximum Variation from Alignment of Columns: 1/4 inch.
- D. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- E. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- F. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- G. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- H. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- I. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.13 CUTTING AND FITTING

- A. Cut and fit for chases and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 00 - Quality Control.
- B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67/C67M requirements, sampling 5 randomly chosen units for each 50,000 installed.
- C. Inspection and Core Tests shall be per DSA IR 21-2.13 and 2105A.4.
 - 1. Inspection: All masonry work is required to be continuously inspected during the laying of masonry, placing of reinforcing steel and grouting by an inspector specially approved for that purpose by DSA. A qualified individual acceptable to the testing laboratory shall make test samples and perform such field tests as are required.
 - 2. The special masonry inspector shall check the materials, details of construction and construction procedure. The inspector shall furnish a verified report on Form DSA-292 certifying that of his or her own personal knowledge the work covered by the report has, in every material respect, been performed in compliance with the DSA approved construction documents.
 - 3. **Core Tests:** Core samples of the completed masonry construction shall be taken in accordance with CBC, Section 2105A.4. Cores shall be a minimum of 3-3/4 inches in diameter and shall be taken in a manner as to exclude masonry unit webs and reinforcing steel. All core samples shall be submitted to the testing laboratory for examination and testing. By visual inspection, core samples appearing to have the lowest quality (largest voids or lack of bond) shall be selected for testing.
 - a. A representative of the testing laboratory shall inspect the coring of the masonry walls and prepare a report of the coring operations. The report shall include the following:
 - 1) Number, location and condition of all cores cut on the project
 - 2) Detailed description of the bond between the grout fill and the cell walls of the masonry unit and
 - 3) Any difficulties encountered in the coring operation which might impair the shear strength of the sample
 - 4) Report results on form DSA-207

3.15 REPAIRING AND POINTING

- A. Repairing: Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

3.16 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.
- E. 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 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 4. Clean concrete unit masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.

3.17 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 22 00
CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Reinforcing steel.
 - 3. Mortar, grout and grouting.
 - 4. Bolts, anchors, hardware, metal frames, and other insert items.
- B. Related Sections:
 - 1. Section 01 45 33 - Code-Required Special Inspections.
 - 2. Section 03 10 00 - Concrete Forming and Accessories.
 - 3. Section 03 20 00 - Concrete Reinforcing.
 - 4. Section 03 30 00 - Cast-in-Place Concrete.

1.02 SUBMITTALS

- A. Mix Design: Submit grouting mix design.
- B. Product Data: Submit manufacturer's Product Data for assembly components, materials, and accessories.
- C. Samples: Submit Samples for each type of required masonry unit, including reinforcement and accessories.

1.03 QUALITY ASSURANCE

- A. Perform the Work in accordance with CBC, Chapter 21A. Refer to Section 01 45 33 - Code-Required Special Inspections.
- B. Comply with requirements of TMS 602/ACI 530.1/ASCE 6.
- C. Concrete Masonry Units: Sample and test in accordance with ASTM C 140.
 - 1. Notify the testing laboratory a minimum of 45 days in advance of installing concrete unit masonry, to allow for testing of the units for compression, shrinkage, and absorption. Absorption test requires 40 days.
 - 2. The retained material testing laboratory shall receive five concrete masonry units per test from masonry unit manufacturer, as designed or specified by the Architect, and shall perform and send required test results to the Architect and IOR.
- D. Portland Cement: Obtain sample and test in accordance with ASTM C 150.
- E. Mortar: Obtain sample and test in accordance with ASTM C 780.
- F. Grout: Obtain sample and test in accordance with ASTM C 404.
- G. Compressive Tests: Obtain sample and test to verify compliance with the following minimum values:

1. Mortar: At least 800 psi at 7 days and 1,800 psi at 28 days.
 2. Grout: At least 1,200 psi at 7 days and 2,000 psi at 28 days.
 3. Do not test 28-day specimen when 7-day tests exceed 28-day requirements.
- H. Inspection During Installation: IOR will continuously observe the installation of reinforced masonry.
- I. The Owner will be responsible for the costs of original tests and inspection.
- J. If core testing is required by DSA, masonry removed by coring operations shall be replaced to match adjoining Work. Core testing shall conform with CBC, Chapter 21A.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store units above grade on level platforms to allow air circulation under stacked units.
- B. Cover and protect against wetting before installation.
- C. Handle units on pallets or flat bed barrows. Free discharge from conveyor units or transportation in mortar trays is not permitted.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete Unit Masonry: Modular medium weight conforming to ASTM C 90, hollow load-bearing concrete unit masonry.
 1. Provide open-end units at walls to be grouted.
 2. Provide closed-end units at walls and at openings where ends will be exposed in finish Work; provide bond beam blocks where horizontal reinforcing is indicated.
 3. Provide special shapes and accessory units at locations indicated on Drawings.
 4. Except as otherwise specified, provide units in standard gray color.
 5. Masonry unit shall have been cured for a minimum of 28 days.
 6. Masonry unit shall have maximum linear shrinkage or 0.065 percent from saturated to oven dry.
- B. Portland Cement: ASTM C 150, Type II, from one source.
- C. Mortar: ASTM C 270.
- D. Grout: ASTM C 476.
- E. Hydrated Lime: ASTM C 207, Type S.
- F. Admixture for Grout: Grout Aid Type 2, complying with DSA requirements; as manufactured by Sika Chemical Corp. Refer to Section 01 45 23: Testing and Inspection.
- G. Water: Potable and fresh.
- H. Cleaning Materials: Shure Klean No. 600 detergent by ProSoCo.
- I. Miscellaneous Materials: As required to complete the Work.
- J. Sampling and Testing of Mortar: Refer to Section 01 45 23: Testing and Inspection.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Discard units with cracked faces, chipped surfaces, or other defects not complying with requirements of ASTM C 216.

3.02 MORTAR AND GROUT MIXING

- A. Mortar: Dry, loose volumes. Mix proportions shall be verified by material testing laboratory.
 - 1. Portland Cement: 1 part.
 - 2. Hydrated lime: 1/4 to 1/2 part.
 - 3. Mortar sand: 2-1/4 to 3 parts.
 - 4. Water: to provide required consistency.
 - 5. Mixing time for Silotec Mortar System shall be in accordance with Silotec Mortar System recommendations instead of those indicated in Section 01 45 23: Testing and Inspection.
- B. Grout: Shall provide a minimum strength of 2000 psi unless noted otherwise. Grout strengths in excess of more than 2000 psi shall be verified by a material testing laboratory.
 - 1. Fine Grout: Portland Cement 1 part; sand 2 ¼ to 3 parts; water to attain a slump of 8 to 10 inches.
 - 2. Coarse Grout: Portland Cement 1 part; pea gravel 2 ¼ to 3 parts; water to attain a slump of 8 to 10 inches.
- C. Measurements: Proportion by accurate volume measurements. Measure in calibrated devices that can be checked at any time.
 - 1. Add water for workable consistency.
 - 2. Shovel measurements are not permitted.
- D. Mixing: Place sand, cement, and water in mixer in that order, while mixer is running; mix for 3 minutes, add lime, and admixture (for grout), and continue mixing until a uniform mass is provided, but in no case less than 10 minutes.
 - 1. Equipment for mixing and handling mortar and grout shall be acceptable to DSA.
 - 2. Batches of less than one sack of cement, and fractional sack batches are not permitted.
- E. Re-tempering Time Limit: Re-temper on mortar boards, for at least 3 minutes, but not more than 10 minutes when required, by adding water into a basin formed by mortar, and installing mortar into it. Dashing, or pouring of water over mortar is not permitted.
 - 1. Do not re-temper mortar which has become hard or non-plastic.
 - 2. Discard mortar, which has not been installed within one hour after original mixing.
 - 3. Ready-Mix Grout: Grout batched off the Project site and delivered by mixer truck shall be subject to same procedures and controls as prescribed by DSA building code requirements. Refer to Section 01 45 33 - Code-Required Special Inspections.

3.03 INSTALLATION OF MASONRY UNITS

- A. Workmanship: Install masonry plumb and true to line with straight level joints of uniform thickness. Maintain masonry clean during and after installation.
 - 1. Lay-out and incorporate embedded hardware items.
 - 2. Assist other trades with built-in items, which require cutting and fitting of masonry.
 - 3. Cut block units with a diamond saw or carborundum wheel. Trowel or chisel cutting is not permitted.
 - 4. Keep cavities clear of droppings and debris. Remove promptly.
- B. Reinforcing Steel: Install as indicated on Drawings. Except as otherwise indicated, install reinforcement in accordance with standards of Concrete Reinforcing Steel Institute and to requirements specified in Section 03 20 00 - Concrete Reinforcing. Do not splice vertical reinforcing except where indicated on the Drawings.
- C. Shoring: Provide temporary shoring for lintels with sufficient strength to carry load without deflecting. Remove temporary shoring 28 days after masonry has been installed.
- D. Block Installation: Clean dirt and dust from surfaces before installation. Do not wet masonry units except in very dry weather.
 - 1. Foundation preparation: Sandblast tops of concrete starting surfaces, wash-off by high pressure water jet, and slurry coat surfaces with neat cement grout for bond to masonry.
 - 2. Install masonry with mortar to required joint thickness. Install blocks with 3/8-inch mortar bed on entire horizontal surface. Fill head joints solid, install tightly to adjoining units. Provide 3/8-inch joint thickness.
 - a. Hold racking to a minimum.
 - b. No toothing is permitted.
 - c. If it becomes necessary to move a unit after it has been installed, remove the unit, discard the mortar, and install the unit in fresh mortar.
 - 3. Anchor Bolts: Provide one-inch minimum grout space around protruding bolts.
 - 4. Bond: Unless otherwise indicated, install units in common running bond.
 - 5. Finish Joint Treatment: Unless otherwise indicated, cut both interior and exterior joints flush, and tool slightly concave to a dense, uniform surface.
 - 6. Grouting: Unless noted otherwise on Drawings, completely fill cells with grout.
- E. Steel Door Frames:
 - 1. Locate doorframes accurately, install plumb, "Ram-set" or "Rawlplug" to floor surface and brace in position before start of masonry installation.
 - a. Frames are specified to be furnished with adjustable anchors.
 - b. Fill interior of frames solid with mortar or grout as walls are constructed.
 - 2. Provide temporary wood spreaders from jamb to jamb and from head to floor to ensure that jambs do not bow-in, distort from a straight line, or deflect from superimposed loads during construction.

3.04 LOW-LIFT GROUTING FOR HOLLOW MASONRY UNITS

- A. After mortar joints have set, cores are cleaned of mortar and debris, and reinforcing is installed and inspected, grout cells in 2 feet maximum lifts, providing specified pea gravel grout mix. Refer to Section 01 45 23: Testing and Inspection.
- B. Grouted walls shall be solid and without voids.
- C. Grout may be installed by pump, tremie or bucket, using hoppers to avoid spilling on exposed surfaces.
- D. Place an initial 2 feet high lift around, thoroughly compact, then place balance of each lift, compacting again through total lift, with hardwood spading sticks or pencil vibrators.
- E. Stop grout pours 1-1/2 inches below top of each lift.
- F. Remove and discard spilled grout from upper units before grout can harden.
- G. Bracing: Adequately brace walls against wind and other forces during and after construction.
- H. Re-puddle top of grout after initial set.

3.05 HIGH-LIFT GROUTING OPTION FOR HOLLOW MASONRY UNITS

- A. High-lift grouting method is permitted provided following qualifications and requirements are met. High-lift grouting shall apply only to cell sizes available with 8 inch and wider block units. This method is subject to approval of DSA.
- B. Provide bond beam units, inverted for start course, and omit alternate blocks or cut openings in alternate face shell on bottom course for cleanouts.
- C. Remove projecting mortar fins. Wash out every cell thoroughly using a water jet, which has sufficient force to remove mortar from the interior of the cells, and from reinforcing steel.
- D. Plug each cleanout by setting a "soap" in mortar into opening and securely bracing it in place to prevent displacement. If masonry is not exposed in finish Work, cleanouts may be formed.
- E. Grouting:
 - 1. Grout masonry cells solid, free from voids.
 - 2. Do not install grout until masonry has set a minimum of 3 days in warm weather (50 degrees to 85 degrees F.) or 5 days in cool, damp weather (35 degrees to 50 degrees F.).
 - 3. Pump grout into grout cell space as rapidly as practical. Discard grout not in place within one hour after water was first added to batch.
 - 4. Install grout with maximum slump without segregation. Place in a continuous pour, in maximum lifts of 4 feet, with approximately 20 minutes elapsed time between any 2 successive lifts.
- F. Consolidating:
 - 1. Consolidate and reconsolidate grout using 3/4 inch lightweight flexible cable vibrators.
 - 2. First consolidation shall be performed to bottom of lift immediately after placement, and in case of subsequent lifts, through previously placed lift.
 - 3. Top lift shall be reconsolidated no sooner than 30 minutes after grout has been installed.
 - 4. Vibrating of reinforcing steel is not permitted.
- G. Bracing: Adequately brace walls against wind and other forces during and after construction.

3.06 CURING

- A. Remove efflorescence, stains, debris, excess grout, and foreign matter.
- B. During curing, or for any other purpose, do not saturate masonry with water.
- C. For low-humidity conditions, dampen the wall surface with a very light fog spray continuously for 3 days to cure mortar in joints.

3.07 PARGE COAT

- A. Apply parge coat to the earth side of surfaces that are to receive waterproofing.
- B. A Portland cement and sand mix (1:3.5 by volume), or Type M or S mortar may be used for the parge coat.
- C. Parging should be applied to damp (not saturated) concrete masonry in two ¼" (6mm) thick layers. The first coat should be roughened when partially set, hardened for 24 hours, and then moistened before second coat is applied. The second coat should be trowelled to a smooth, dense surface.
- D. The parge coat should be beveled at the top to form a wash, and thickened at the bottom to form a cove between the base of the wall and the top of footing.

3.08 CLEANING

- A. At completion of masonry Work, remove misplaced mortar, grout or other foreign substances, and clean surfaces which will be exposed in finish Work with specified cleaner, or with clean water and stiff fiber brushes.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.09 PROTECTION

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

END OF SECTION

SECTION 05 05 19
POST-INSTALLED CONCRETE ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for materials and equipment for post-installed mechanical and adhesive anchors in concrete.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Section 01 45 00 - Quality Control: Test reporting.
- C. Section 01 63 00 - Product Substitution Procedures: Requirements for material and product quality.
- D. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- E. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.
- F. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.
- G. Section 05 31 00 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- H. Section 05 50 00 - Metal Fabrications.
- I. Section 05 51 00 - Metal Stairs.
- J. Section 05 52 13 - Pipe and Tube Railings.
- K. Divisions 10 - Specialties, 22 - Plumbing, and 26 - Electrical: Mounting of equipment and components.
- L. Other miscellaneous sections, where indicated.

1.03 REFERENCE STANDARDS

- A. ASTM A193/A193M - Standard Specification for Alloy - Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2016.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
- E. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2015.
- F. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2015).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

- B. Product Data: If requested, manufacturer's product literature and installation instructions for each type of anchor indicated.
- C. Samples: If requested, representative length and diameters of each type of anchor shown on the drawings.
- D. ICC ES Reports: If requested, ICC Evaluation Service report indicating conformance with ICC-ES Acceptance Criteria.
- E. Field quality-control test and inspection reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 and Section 01 45 00 for testing indicated.
- B. 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's or distributor's original packaging undamaged, and with printed installation instructions.
- B. Store and handle all materials in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Provide products as indicated on the approved Structural Drawings.
- B. Substitutions: Substitutions of products from manufacturer's not listed are not permitted..

2.02 MATERIALS

- A. Interior Use: For use in conditioned environments free from potential moisture, provide zinc plated carbon steel anchors.
- B. Exterior Use:
 - 1. In exposed or potentially wet environments, and for attachment of exterior cladding materials, provide stainless steel anchors.
 - 2. Stainless steel nuts and washers shall be of matching alloy group of equal or greater strength than the rod.
 - 3. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
- C. Deformed Reinforcing Bars: Deformed steel rebar conforming to ASTM A615/A615M Grade 60. Permissible sizes as described in each adhesive products ICC report.

2.03 MECHANICAL ANCHORS

- A. Expansion, screw or undercut anchors having current ICC approval for use in cracked and uncracked concrete, with a published ICC Evaluation Service report.
 - 1. Type and size as indicated on drawings.

2. If products are not indicated, then provide anchors as directed by the Architect.
- B. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as indicated on Drawings:
1. Hilti, Inc. Tulsa, OK; Hilti Kwik Bolt TZ Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete (ICC Report ESR-1917); www.us.hilti.com.
 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:
1. Simpson Wedge-All Wedge Anchor (ICC-ES ESR-1396)
 2. Hilti Kwik Bolt 3 Expansion Anchor (ICC-ES ESR-1385)
 3. Hilti Kwik Bolt TZ Expansion Anchor (ICC-ES ESR-3785)
 4. Simpson Titen HD Screw Anchor (ICC-ES ESR-1056)

2.04 ADHESIVE ANCHORS

- A. Cartridge Injection Adhesive Anchors: Threaded carbon steel rod, inserts, or reinforcing dowels complete with required nuts, washers, adhesive system and manufacturer's installation instructions.
1. Type and size as indicated on drawings.
 2. Current ICC approval for use in cracked and uncracked concrete with a published ICC Evaluation Service report required.
- B. Interior Use: Unless otherwise indicated on the Drawings, provide:
1. 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).
- C. Exterior Use: As indicated on the Drawings, provide stainless steel anchors.
1. 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.
 2. All nuts shall conform to ASTM F594, unless otherwise specified.
- D. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as indicated on Drawings:
1. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- E. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:

2.05 CONCRETE AND MASONRY SCREW ANCHORS

- A. Anchors shall be manufactured from carbon steel which is then heat-treated.
1. Anchors shall be zinc-plated in accordance with ASTM B633, Class SC1, Type III.
 2. Current ICC approval for use in cracked and uncracked concrete with a published ICC Evaluation Service report required.

3. Provide anchors with a diameter and anchor length marking on the head.
 4. If products are not indicated, then provide anchors as directed by the Architect.
- B. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as follows:
1. Simpson Strong-Tie Company, Inc.; Simpson Titen HD anchor, (ICC Report ER-2713) heavy duty screw anchor for concrete; www.simpsonanchors.com.
 2. Hilti, Inc.; Hilti KWIK HUS-EZ (KH-EZ) and KWIK HUS-EZ I (KH-EZ I) Carbon Steel Screw Anchors For Use In Cracked and Uncracked Concrete (ICC Report ESR-3027); www.hilti.com.

2.06 POWDER-DRIVEN FASTENERS

- A. Use only if approved by Architect, generally not permitted where not specifically indicated or in load-bearing installations; Fed Spec FF-P-395 or Fed Spec GGG-D-777; as follows.
1. Hilti, Inc.; Hilti Low Velocity Powder Driven Fasteners (ICC Report ESR-1663); www.us.hilti.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions
1. Base Material Strength: Unless otherwise specified, do not drill holes in concrete until concrete has achieved full design strength.
 - a. Adhesive anchors shall be installed in concrete having a minimum concrete compressive strength equal to or greater than the specified minimum 28-day compressive strength or a minimum age of 21 days at time of anchor installation. Whichever are more restrictive.
 2. Temperature of concrete surface and ambient air temperature must meet manufacturer's requirements prior to use of adhesive anchor products.
 3. Embedded Items:
 - a. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors.
 - b. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items.
 - c. Take precautions as necessary to avoid damaging anything embedded in the concrete including electrical/telecommunications conduit, gas pipes, and plumbing pipes.
 - d. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling.
 4. Beginning of installation indicates acceptance of existing conditions.

3.02 INSTALLATION

- 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 ECR 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.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 00 - Quality Control.
- 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 and CBC 1913A.5.
 - c. Post-Installed Anchor Load Testing: CBC Section 1910A5.2 and 1910A.5.3

- 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. CBC 1910.5.2
 - 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.

3.04 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 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Architecturally exposed structural steel.
- B. Related Sections:
 - 1. Section 01 45 00 - Quality Control.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.
 - 3. Section 04 20 00 - Unit Masonry
 - 4. Section 05 12 13 - Architecturally-Exposed Structural Steel Framing
 - 5. Section 05 31 00 - Steel Decking.
 - 6. Section 05 50 00 - Metal Fabrications.
 - 7. Section 09 91 13 - Exterior Painting.
 - 8. Section 09 91 23 - Interior Painting.

1.02 REFERENCES

- A. AISC Steel Construction Manual:
 - 1. AISC 360 Specifications for Structural Steel Buildings.
 - 2. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- B. AISC 341 - Seismic Provisions for Structural Steel Buildings, including Supplements.
- C. AISC S323 - Quality Criteria and Inspection Standards.
- D. AISC - American Institute of Steel Construction, Code of Standard Practice for Steel Buildings and Bridges, for Architecturally Exposed Structural Steel.
- E. ASTM A36 - Structural Steel.
- F. ASTM A53 - Hot Dipped, Zinc-Coated Welded and Seamless Steel Pipe.
- G. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold-Finish, Standard Quality.
- H. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- I. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- J. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- K. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- L. ASTM A500 - Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- M. ASTM A572 - Grade 50 - Structural Steel.
- N. ASTM A653 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated by the Hot-Dip Process.

- O. ASTM A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- P. ASTM A992 - Steel for Structural Shapes For Use in Building Framing.
- Q. ASTM C1107 - Packaged Dry, Hydraulic Cement Grout (Non-Shrink).
- R. ASTM F1554 - Standard Specification for Anchor Bolts.
- S. AWS A2.4 - Standard Welding Symbols.
- T. AWS D1.1 - Structural Welding Code.
- U. AWS D1.8 - Structural Welding Code – Seismic Supplement.
- V. AWS WHB-1 - Qualification and Certification.
- W. AWS A5.1 - Carbon Steel Covered Arc-Welding Electrodes.
- X. CBC Chapter 22A, Division III - Allowable Stress Design and Plastic Design for Structural Steel Buildings.
- Y. SSPC - Steel Structures Painting Council, SP-2, Hand Tool Cleaning.
- Z. Federal Emergency Management Agency (FEMA)
 - 1. FEMA 353 - Recommended Specification and Quality Assurance Guidelines for Steel Moment Frame Construction for Seismic Application, July 2000.

1.03 SYSTEM DESCRIPTION

- A. Regulatory Requirements:
 - 1. Structural steel shall conform to CBC requirements, except that steel manufactured by acid Bessemer process is not permitted for structural purposes.
 - 2. Sheet and strip steel other than those listed in CBC, if provided for structural purpose, shall comply with DSA requirements.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit Shop Drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar detailing as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked in stresses and distortion; submit sequence and technique plan for review by the Architect.
 - a. Include details of cuts, connections, camber, and holes in accordance with Figure 4.5 of AWS D1.1 or AISC Chapter J, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.
 - b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed for Work specified in other section.
 - c. Erection and Bracing Plan and Erection Procedure: Submit an erection and framing plan, including columns, beams, and girders, prepared, signed and sealed by a structural engineer registered in the State of California in accordance with Title 8

CCR, Section 1710. Maintain a copy at the Project site as required by the California Division of Industrial Safety.

- d. Submit a list of steel items to be galvanized.
2. Product Data:
 - a. Submit copies of fabricator's specifications and installation instructions for the following products. Include laboratory test reports and other data required demonstrating compliance with these Specifications:
 - 1) Structural steel, each type; including certified copies of mill reports covering chemical and physical properties.
 - 2) Welding electrodes.
 - 3) Welding gas.
 - 4) Unfinished bolts and nuts.
 - 5) Structural steel primer paint.
 - 6) High-strength bolts, including nuts and washers.
3. Manufacturer's Mill Certificate:
 - a. Submit, certifying that products meet or exceed specified requirements.
4. Mill Test Reports:
 - a. Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.
5. Charpy-V-Notch (CVN) Impact Test: Submit certified copies of Charpy-V-Notch (CVN) Impact Test by the manufacturer for applicable steel members and components.
 - a. Charpy-V-Notch (CVN) Impact Test for Base Metal: hot rolled shapes with flanges 1-1/2 in. thick and thicker and plates 2 in. thick and thicker shall be subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part A3.3.
 - b. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A 673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E 23. The absorbed energy in a CVN impact test shall not be less than that specified in "Seismic Provisions for Structural Steel Buildings", Part A3.3.
6. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured using fully killed fine grain practice having grain size number 5 or better as determined by ASTM E 112.
7. Weld Procedures: Submit weld procedures for all welding on project to Owner's testing laboratory for approval. After approval by testing laboratory, submit to Architect for record. Weld procedures shall be qualified as described in AWS D1.5, Section 5.12 or 5.13 for self shielded FCAW, Weld procedures shall indicate joints details and tolerances, preheat and interpass temperature, post-heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last pass, electrode type and size, welding current, polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged, from these averages the weld heat input shall be calculated. Submit the manufacturer's product data sheet for all welding material used.

8. Welder's Certificates: Field welders shall be Project certified in accordance with AWS D1.1. Shop welders shall be Project certified for FCAWS in accordance with AWS D1.1.
9. Test Reports: Submit reports of tests conducted on shop and field welded and bolted connections. Include data on type of test conducted and test results.
10. Welding Material Certification: Comply with FEMA 353, Part I, Section 1.4.6.3. Submit to Owner's testing laboratory.

1.05 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement, except as otherwise indicated:
 1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges,
 2. Perform welding in accordance with AWS Standards, AWS D1.1, and California Building Code Section 2204A.1 and approved Weld Procedure Specifications (WPS)..
- B. Shop fabrication shall be inspected in accordance with CBC.
- C. Erect mock-up panel of fabricated structural steel meeting Architecturally Exposed Structural Steel tolerances for exposed areas. Approval by Architect is required. Mock-up to remain for comparison but may not be left as part of the work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store structural steel above grade on platforms, skids or other supports.
- B. Protect steel from corrosion.
- C. Store welding electrodes in accordance with AWS D1.1.
- D. Store other materials in a weather-tight and dry place until installed into the Work.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Stock Materials: Provide exact materials, sections, shapes, thickness, sizes, weights, and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered if net area of shape or section is not reduced thereby, if material and structural properties are at least equivalent, and if overall dimensions are not exceeded.

2.02 MATERIALS

- A. Structural Steel: All wide flange shapes shall conform to ASTM A992 Grade 50. Moment Frame Base Plate shall be ASTM A572 Grade 50. Other steel shall conform to ASTM A36.
- B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon bolts and nuts.
- C. High-Strength Threaded Fasteners: ASTM A325, ASTM A490 or ASTM F1852 quenched and tempered, steel bolts, nuts and washers.
- D. Primer: Lead-free metal primer, Tnemec 10-99, Rust-Oleum X-60, or equal.
- E. Steel Pipe: ASTM A53, Type E or S, Grade B.
- F. Structural Tubing:
 1. Hot-formed, ASTM A501.

2. Cold-formed, ASTM A500, Grade B.
- G. Galvanizing: ASTM A123.
- H. Welding Electrodes: Provide electrodes recommended by manufacturer for seismic connections.
 1. Comply with FEMA 353, Part I, Section 2.4.1., Supplemental Requirements or Welding Materials.
- I. Shear stud connectors: ASTM A1044, Grade 1015 forged steel, headed, uncoated, granular flux filled shear connector or anchor studs by Nelson Stud Welding Division of TRW, Lorain, OH, or equal.
- J. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at 7 days; of consistency suitable for application and a 30 minute working time.

2.03 FABRICATION

- A. Cleaning and Straightening Materials: Materials being fabricated shall be thoroughly cleaned of scale and rust, and straightened before fabrication. Cleaning and straightening methods shall not damage material. After punching or fabrication of component parts of a member, twists or bends shall be removed before parts are assembled.
- B. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall perform the cutting, punching, drilling and tapping of Work so that Work of other trades will properly connect to steel Work.
- C. Milling: Compression joints depending on contact bearing shall be furnished with bearing surfaces prepared to a common plane by milling.
- D. Use of Burning Torch: Oxygen cutting of members shall be performed by machine. Gouges greater than 3/16 inch that remain from cutting shall be removed by grinding. Reentrant corners shall be shaped notch free to a radius of at least 1/2 inch. Gas cutting of holes for bolts or rivets is not permitted.
- E. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized in largest practical sizes. Fabrication includes operations of shearing, punching, bending, forming, assembling or welding. Galvanized items shall be free from projections, barbs, or icicles resulting from the galvanizing process.
- F. Welding:
 1. Type of steel furnished in welded structures shall provide chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the requirements of CBC Chapter 17A. Conform to AWS D1.1, and CBC Chapter 22A, Division I, Section 2205A.10.
 2. Materials and workmanship shall conform to the requirements specified herein and to CBC requirements, modified as follows:
 - a. No welded splices shall be permitted except those indicated on Drawings unless specifically reviewed by the Architect.
 - b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.

3. Welding shall be performed in accordance with requirements of the AWS Structural Welding Code.
 - a. Welded Joint Details: comply with FEMA 353, Part I, Section 4, Welded Joint Details and Section 5.5.1, Tack Weld.
 4. Architecturally Exposed Structural Steel: Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds ½ inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.
 5. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Shop Finish:
1. Notify the IOR when Work is ready to receive shop prime coat. Work shall be inspected by the IOR before installation of primer.
 2. Structural steel and fittings, except galvanized items, which will be exposed when building is completed, shall receive a coat of primer.
 3. The primer specified shall be spray applied, filling joints and corners and covering surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils.
 4. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete or high strength bolted.
- H. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- I. Fabricate Architecturally Exposed Structural Steel with exposed surfaces smooth, square, and free of surfaces blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
 2. Comply with fabrication requirements, including tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for Architecturally Exposed Structural Steel.
- J. Reduced Beam Sections (RBS's): Fabrication of RBS's as defined in FEMA 350, 3.5.5, shall conform with FEMA 353, Part I, Section 5.1.

2.04 SHOP AND FIELD QUALITY CONTROL

- A. A special inspector, approved by DSA to inspect the Work of this section, shall inspect high-strength bolted connections. The Owner will provide a DSA approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC 1705A2.5. The IOR shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- B. An AWS CWI certified special inspector, approved by DSA to inspect the Work of this section, shall inspect welded connections. The Owner will provide a DSA approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC

1705A2.5. The IOR shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.

- C. The independent testing laboratory shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.
- D. Provide access to all places where structural steel Work is being fabricated or produced so required inspection and testing can be performed.
- E. The independent testing laboratory may inspect and/or test structural steel at plant before shipment; however, Architect reserves the right at any time before Final Completion to deem materials not in compliance with the specified requirements as defective Work.
- F. Correct defects in structural Work when inspections and laboratory test reports indicate noncompliance with specified requirements. Perform additional tests as may be required to reconfirm noncompliance of original Work, and as may be required to show demonstrate compliance of corrected Work.
- G. Welding: Inspect and test during fabrication and erection of structural steel assemblies as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the Work. Record Work required and performed to correct deficiencies.
 - 2. Inspect welds. Welds shall be visually inspected before performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved non-destructive test methods. Testing shall be performed to AWS D1.1 Table 6.3 cyclically loaded non-tubular connections.
 - 3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Repair and test defective welds.
 - 4. Rate of Testing: Completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.
 - 5. Welds, when installed in column splices, shall be tested by either ultrasonic testing or radiography.
 - 6. Base metal thicker than 1-1/2 inches, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities directly behind such welds. Tests shall be performed at least 48 hours after completed joint has cooled down to ambient air temperature.
 - 7. Any material discontinuities shall be reviewed based on the defect rating in accordance with the criteria of AWS D1.1 table 6.3 by the Architect and DSA.
 - 8. Other method of non-destructive testing and inspection, for example, liquid dye penetrate testing, magnetic particle inspection or radiographic inspection may be performed on weld if required.
 - 9. Lamellar Tearing: Lamellar-tearing resulting from welding is a crack (with ero tolerance) and shall be repaired in accordance with AWS D1.1.
 - 10. Lamination: The rejection criteria shall be based on ASTM A 435.

11. Where testing reveals lamination or conditions of lamellar tearing in base metal, the steel fabricator shall submit a proposed method of repair for review by the Architect. Test repaired areas as required.
 12. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 - Qualification.
- H. Lamellar Tearing: Prior to welding plates 1 to 1-1/2 inches thick and greater and rolled shapes within the distance from 6 inches above the top of the joint to 6 inches below the bottom of the joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur, members will be reviewed by the Architect and DSA. Welding procedure specifications in sub-section 1.5G specify welding practices to minimize lamellar tearing.
 - I. Prior Testing of Base Material: Test material before fabrication.
 - J. Lines and levels of erected steel shall be certified by a State of California licensed surveyor as set forth in related Division 01 section.
 - K. Welded studs shall be tested and inspected by the special inspector in accordance with requirements of AWS D1.1 - Stud Welding.
 - L. Record Drawings: After steel has been erected, correct or revise Shop Drawings and erection diagrams to correspond with reviewed changes performed in the field.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 ERECTION

- A. Install structural steel accurately in locations, to elevations indicated, and according to AISC specifications and CBC requirements.
- B. Clean surfaces of base plates and bearing plates.
 1. Install base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims; cut off flush with edge of base or bearing plate before packing with grout.
- C. Maintain erection tolerances of structural steel within AISC Code of Standard Practice for Steel Buildings and Bridges.

1. Members and components, plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. Contractor to provide adjustable connections between Architecturally Exposed Structural Steel and the structural steel frame or the masonry or concrete supports, in order to provide the erector with means for adjustment.
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
- E. Do not permit thermal cutting during erection of structural steel.
- F. Where indicated for field connections, provide standard bolts complying with ASTM A 307.
- G. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with CBC requirements.
 1. Allowable hole sizes: 1/16 inch larger than bolt size.
 2. Use friction type connection with standard hardened steel circular, square or rectangular washer under bolt nut.
 3. Thoroughly clean area under bolt head, nut and washer. Remove all paint, lacquer, oil or other coatings except organic zinc-rich paints in accordance with SSPC, SP-2.
 4. Tighten bolts by power torque wrench or hand wrench until twist-off.
- H. Contractor shall be responsible for correcting detailing and fabrication errors and for correct fitting of all members and components.
- I. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide temporary bracing, supports or connections required for complete safety of structure until final permanent connections are installed.
- J. Install column bases within a tolerance of 1/8 inch of detailed centerlines, level at proper elevations. Support bases on double nuts and solidly fill spaces under bases with dry-pack cement grout.
- K. Provide anchor bolts with templates and diagrams. Contractor shall be responsible for proper location and installation of bolts. Correct deficiencies and errors.
- L. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780.

3.03 FITTING

- A. Closely fit members, finished true to line and in precise position required to allow accurate erection and proper joining in the field.
- B. Drilling to enlarge unfair holes will not be allowed. Allow only enough drifting during assembly to bring parts into position, but not sufficient enough to enlarge holes or distort the metal. Do not heat rolled sections, unless approved by Architect.

3.04 PUNCHING AND DRILLING

- A. Punch material 1/16 inch larger than nominal diameter of bolt, wherever thickness of metal is equal to or less than the diameter of the bolt plus 1/8 inch.

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

3.05 FINISHING

- A. After erection, spots or surfaces where paint has been removed, damaged, or burned off and field rivets, bolts, and other field connections not concealed in the work, shall be cleaned of dirt, oil, grease, and burned paint and furnished with a spot coat of the same primer installed during shop priming.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Install paint to exposed areas with the same material installed during shop painting. Install by brush or spray to provide a minimum dry film thickness of 1.5 mils.

3.06 FIELD QUALITY CONTROL

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

3.07 CLEAN UP

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

3.08 PROTECTION

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

3.09 HANDLING

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

END OF SECTION

SECTION 05 12 13
ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.
- B. Section 09 91 13 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- C. Section 09 91 23 - Interior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- D. Section 09 96 00 - High-Performance Coatings: Finish coat requirements and coordination with primer and surface preparation specified in this section.

1.03 DEFINITIONS

- A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.

1.04 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. AISC 360 - Specification for Structural Steel Buildings; 2010.
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2016.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- G. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.
- H. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- K. SSPC-SP 1 - Solvent Cleaning; 2015.

- L. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting at project site one week prior to start of work of this section; require attendance by all affected installers. Coordinate requirements for shipping, special handling, storage, attachment of safety cables and temporary erection bracing, final coating, touch-up painting, mock-up coordination, Architect's observations, and other requirements for AESS.

1.06 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product data for each type of product specified. Submit paint systems in accordance with Section 09 91 13.
- C. Shop Drawings: Detailing for fabrication of AESS components.
 - 1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
 - 2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
 - 3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
 - 4. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
 - 5. Indicate type, size, finish and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Indicate orientation of bolt heads.
 - 6. Indicate which surfaces or edges are exposed and what class of surface preparation is being used.
 - 7. Indicate special tolerances and erection requirements as noted on drawings or defined by the designated AESS category.
 - 8. Indicate vent or drainage holes for HSS members.
- D. AESS 1, AESS 2, AESS 3, AESS 4, and AESS C Samples: Provide samples of specific AESS characteristics. Samples may be small size samples or components of conventional structural steel demonstrating specific AESS characteristics, including surface preparation, sharp edges ground smooth, continuous weld appearance, weld show through, and fabrication mark removal.
- E. Qualification data for fabricator and erector to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of architects and owners, photographs showing detail of installed AESS, and other information specified.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 12 00, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this

project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.

- B. Erector Qualifications: In addition to those qualifications listed in Section 05 12 00, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- C. Comply with applicable provisions of AISC 303, Section 10 for the designated AESS category.
- D. Contractor to engage a quality assurance agency per requirements of AISC 360, Chapter N and AISC 303, Section 10.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Comply with Section 05 12 00, except as amended in this section for aesthetic purposes.
- B. Provide AESS on all exterior steel fabrications on the building below the roof cornice line.
- C. Comply with AISC 303, Section 10 for specific AESS as follows:
 - 1. Architectural Trim: AESS 1.
 - 2. Canopies: AESS 3.
 - 3. Stairs: AESS 4, if indicated as Architectural Quality in Section 05 51 00 - Metal Stairs.
 - 4. Trellis: AESS 3.

2.02 FABRICATION

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. For curved structural members, whether composed of a single standard structural shape or built-up, the as-fabricated variation from theoretical curvature to be equal to or less than standard camber and sweep tolerances permitted for straight members in applicable ASTM standard.
- D. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- E. Bolted Connections:

1. Make in accordance with Section 05 12 00. Provide bolt type and finish as noted herein.
- F. Welded Connections:
1. Comply with AWS D1.1/D1.1M and Section 05 12 00.
 2. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerances of this section.
- G. Surface Preparation:
1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 2. Remove backing and run out tabs.
- H. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
1. AESS 1: Basic elements.
 2. AESS 2: Feature elements viewed at a distance greater than 20 feet (feature elements not in close view).
 3. AESS 3: Feature elements viewed at a distance less than 20 feet (feature elements in close view).
 4. AESS 4: Showcase elements with special surface and edge treatment beyond fabrication (showcase elements).
 5. AESS C: Custom elements; fabricate to requirements of AESS 1 and the following characteristics:

2.03 PAINT SYSTEM

- A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 09 91 13, 09 91 23, and 09 96 00. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.
- B. Primer: As specified in Sections 09 91 13, 09 91 23, and 09 96 00. Primer to comply with all federal standards for VOC, lead and chromate levels.
- C. Finish Coating: Field apply intermediate and top coats per Sections 09 91 13, 09 91 23, and 09 96 00.

2.04 SHOP PRIMING

- A. Surface Preparation:
1. Provide surface preparations to meet SSPC-SP 6.
 2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
 3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
 4. Remove weld spatter, slivers and similar surface discontinuities.
 5. Ease sharp corners resulting from shearing, flame cutting or grinding.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.

1. Extend priming of members partially embedded in concrete or mortar to a depth of 2 inches.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 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 primer to surfaces that are inaccessible after assembly or erection.

2.05 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

2.06 MATERIALS

- A. General: Meet requirements of 05 12 00 as amended below.
- B. Tension Control, High-Strength Bolts, Nuts, and Washers: Per section 05 12 00, Tension Control Bolts. Provide standard carbon steel finish rounded bolt heads with twist off bolts; ASTM F3125/F3125M.

2.07 SOURCE QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, for additional requirements.
- B. Structural Requirements:
 1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 12 00 for additional requirements.
 2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.
- C. AESS 1 and 2 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.
- D. AESS 3,4, and C Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on approved mock-up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.
- B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

- A. AESS 1 and 2: Basic elements; feature elements not in close view:
 - 1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
 - 2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
 - 3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
 - 4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 - 6. Remove all backing and run out tabs.
 - 7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
 - 8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
 - 9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 05 12 00. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
 - 10. Remove weld spatter exposed to view.
 - 11. Grind off projections larger than 1/16 inch at field butt and plug welds.
 - 12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
 - 13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
 - 14. Splice members only where indicated.
 - 15. Obtain permission for any torch cutting or field fabrication from Architect. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.
- B. AESS 3: Feature elements in close view:
 - 1. Erect to requirements of AESS 1 and 2 and as follows:

2. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
 3. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.
- C. AESS 4: Showcase elements:
1. Erect to requirements of AESS 3 and as follows:
 2. Grind welds smooth.
 3. Minimize Weld Show Through: At locations where welding on far side of an exposed connection creates distortion, grind distortion and marking of steel to a smooth profile with adjacent material.
 4. Filling of Weld Access Holes: Where holes must be cut in web at intersection with flanges on W shapes and structural tees to permit field welding of flanges, fill holes with joint filler.
 5. Where welds are indicated to be ground, contoured, or blended, oversize welds as required and grind to provide a smooth transition and match profile on approved mock-up.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, for additional requirements.
- B. Structural Requirements:
1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 12 00 for additional requirements.
 2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.
- C. AESS 1 and 2 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.
- D. AESS 3,4, and C Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals as well as on approved mock- up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.05 CLEANING

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 91 13, 09 91 23, and 09 96 00.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas. Repair galvanized surfaces in accordance with ASTM A780/A780M.
- C. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION

SECTION 05 31 00
STEEL DECKING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal decking.
 - 2. Shear connectors.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 45 00 - Quality Control.
 - 3. Section 05 12 00 - Structural Steel Framing.

1.02 REFERENCES

- A. AISI - Specifications for the Design of Cold-Formed Steel Structural Members.
- B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- C. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- E. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
- F. AWS D1.3 - Structural Welding Code Sheet - Steel.

1.03 PERFORMANCE REQUIREMENTS

- A. Compute properties of deck sections on basis of effective design width as limited by provisions of the AISI specifications. Provide no less than deck section properties specified, including section modulus and moment of inertia per foot of width.
- B. Regulatory Requirements:
 - 1. Requirements of Regulatory Agencies: DSA and Underwriters Laboratories Inc. (UL) approval for the decking when installed as a part of an assembly indicated on Drawings in which fire resistive construction ratings are required.
 - 2. Work of this section shall be in accordance with CBC.
- C. Manufacturers shall be members of Steel Deck Institute (SDI).

1.04 SUBMITTALS

- A. Shop Drawings: Drawings, sections and details indicate type of decking, location, finish, gage of metal, arrangement of sheets, necessary fabrication to incorporate decking into the Work, and relationship to openings and flashing.

1.05 QUALITY ASSURANCE

- A. General: Metal decking steel shall conform to requirements of strengths and properties of standards specified.
- B. Qualifications of Welders: Properly certified for the type of Work involved in compliance with CBC requirements.
- C. Continuous inspection of welding will be performed by a special inspector, approved by DSA to inspect the Work of this section. Refer to Section 01 45 00 - Quality Control. The Project Inspector shall be responsible for monitoring the work of the special inspector to ensure that the inspection program is satisfactorily completed.
- D. Identification of metal decking steel shall conform to the standards specified in Section 01 45 00 - Quality Control.
 - 1. Fabricator shall furnish sufficient evidence to the Architect attesting compliance with specified requirements.
 - 2. Conform to CBC requirements. Unclassified or unidentified decking is not permitted. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having a minimum Fy of 33 Ksi. In addition, for decking having Fy greater than 33 Ksi, testing laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.
- E. Unidentifiable Steel: Steel which is not readily identifiable as to grade from markings and test records is not permitted to be provided as part of the Work of this section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ASC Steel Deck.
- B. Verco Manufacturing Co.
- C. Epic Metals Corporation.
- D. Equal.

2.02 MATERIALS

- A. Metal Decking: Roll-formed sheets conforming to ASTM A653, with G90 zinc coating.
 - 1. Section properties shall conform to applicable provisions of latest edition of AISI - Specification for the Design of Cold-Formed Steel Structural Members.
- B. Flexible Closure Strips for Deck: Vulcanized, closed-cell, expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE #41.
 - 1. Brittleness Temperature: Minus 40 degrees F, ASTM D746.
 - 2. Flammability Resistance: Self-extinguishing,
- C. Metal Flashing and Closures: 22 gage minimum, with ASTM A653, G90 zinc coating.
- D. Shear Connectors: Headed stud type, ASTM A108 Grade 1015, cold-finished carbon steel complying with AISC specifications.

2.03 FABRICATION

- A. Corrugated sheets or sections shall be designed to support required live load between supporting members.
- B. Provide decking in lengths to span over three or more supports.
- C. Except as detailed otherwise, provide decking with interlocking side laps, 2 ½-inch minimum end bearing, and 1 ½-inch minimum side bearing.
- D. Welding: Provide materials and methods in accordance with recommendations of steel decking manufacturer and reviewed submittals. Hold decking tight to the supporting elements with screws or other means for proper welding or crimping of the decking edges. Conform to AWS D1.3, and to the patterns and weld types indicated, with welds free from sharp edges and protrusions. Field coat welds and abraded surfaces at completion with an anodic type galvanizing repair paint. Omit the field paint coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.

PART 3 - EXECUTION

3.01 OPENINGS

- A. Cut and reinforce units to provide openings which are located and dimensioned on the structural and mechanical Drawings.
- B. Provide openings, or other Work not indicated on the Drawings.

3.02 INSTALLATION

- A. Install metal decking in accordance with decking manufacturers' recommendations, requirements of Drawings, Shop Drawings, and Specifications.
- B. Install metal decking on supporting steel framework and adjust to final position before permanently fastening in place.
 - 1. Install each unit to proper bearing on supports.
 - 2. Install units in straight alignment for entire length of run of cells with close registration of cells of one unit with those of abutting unit.
- C. Fasten decking to steel framework at ends of units and at intermediate supports. Welding shall be as indicated on Drawings.
- D. Fasten side laps between supports as indicated on Drawings.
- E. Perform field cutting parallel with cells in area between cells, leaving sufficient horizontal material to permit welding to support steel.
- F. Weld shear connectors to supports thru decking units as required by Drawings. Weld only on clean, dry surfaces. Do not weld shear connectors thru two layers of decking units.

3.03 METAL FLASHINGS AND CLOSURES

- A. Furnish, install, and weld in position, sheet metal closure flashing, closure angles, closure plates, profile plates, and shear plates.
- B. Close open ends of cell runs at columns, openings, walls, similar interruptions and termination.

3.04 FIELD QUALITY CONTROL

- A. Inspection: Install steel decking under continuous inspection according to CBC Chapter 1704A.3.
 - 1. Welding inspection for steel deck diaphragms shall conform to CBC Section 2204A.1.

3.05 CLEAN UP

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

3.06 PROTECTION

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

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior load-bearing wall framing.
- B. Interior load-bearing wall framing.
- C. Exterior non-load-bearing, curtain-wall framing.
- D. Floor joist framing.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads without deflections greater than the following:
 - 1. Exterior Load-Bearing Wall Framing: Horizontal deflection of L/240 of the wall height.
 - 2. Interior Load-Bearing Wall Framing: Horizontal deflection of L/240 of the wall height.
 - 3. Exterior Non-Load-Bearing, Curtain-Wall Framing: Horizontal deflection of L/360 of the wall height.

1.03 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Include layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
- C. Mill certificates.
- D. Welder certificates.
- E. Research/evaluation reports.

1.04 QUALITY ASSURANCE

- A. Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing. Retain subparagraph below with "Performance Requirements" Article.
 - 1. Engineering Responsibility: Engage a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data.
- B. Mill certificates signed by steel sheet producer
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E119 by a testing agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing agency.

- E. Comply with HUD's "Prescriptive Method for Residential Cold-Formed Steel Framing."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied American Studco, Inc.
 - 2. Angeles Metal Systems.
 - 3. California Expanded Metal Products Co.
 - 4. California Metal Systems, Inc.
 - 5. Clark Steel Framing Industries.
 - 6. Consolidated Fabricators Corp.
 - 7. Consolidated Systems, Inc.
 - 8. Dale Industries, Inc.
 - 9. Design Shapes in Steel.
 - 10. Dietrich Industries, Inc.
 - 11. Knorr Steel Framing Systems.
 - 12. MarinoWare; Div. of Ware Industries, Inc.
 - 13. Scafco Corp.
 - 14. Steel Construction Systems.
 - 15. Steel Developers, LLC.
 - 16. Steeler, Inc.
 - 17. Studco of Hawaii, Inc.
 - 18. Super Stud Building Products, Inc.
 - 19. Unimast, Inc.
 - 20. United Metal Products, Inc.
 - 21. Western Metal Lath.

2.02 MATERIALS

- A. Steel Sheet: ASTM A 653/A 653M, structural steel, G60 (Z180) zinc coating, Grade 33 for minimum uncoated steel thickness of 0.0428 inch and less; Grade 50 for minimum uncoated steel thickness of 0.0538 inch and greater.
- B. Wall Framing: Manufacturer's standard steel studs, of web depths indicated, with stiffened flanges, complying with ASTM C 955.

- C. Joist Framing: Manufacturer's standard C-shaped steel joists, of web depths indicated, [unpunched] [punched], with stiffened flanges, complying with ASTM C 955..

2.03 ACCESSORIES AND MISCELLANEOUS MATERIALS

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi, of manufacturer's standard thickness and configuration, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123.
- C. Anchor Bolts: ASTM F1554, Grade 55, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
- G. Cement Grout: Portland cement, ASTM C150, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- H. Thermal Insulation: ASTM C665, Type I, unfaced mineral-fiber blankets produced by combining glass or slag fibers with thermosetting resins.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Preparation: Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction. contact of bearing flanges or track webs on supporting concrete or masonry construction.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to ASTM C1007, manufacturer's written recommendations, and requirements in this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - 3. Install framing members in one-piece lengths.
 - 4. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed.

5. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
 6. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- C. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- D. Load-Bearing Wall Installation: Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends. Squarely seat studs against webs of top and bottom tracks. Space studs as indicated, set plumb, align, and fasten both flanges of studs to top and bottom tracks.
1. Align studs vertically where wall-framing continuity is interrupted by floor framing. Where studs cannot be aligned, continuously reinforce track to transfer loads.
 2. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
 3. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
 4. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 5. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings.
 6. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
 7. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.
 8. Install miscellaneous framing and connections, including supplementary framing, blocking, bracing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- E. Non-Load-Bearing, Curtain-Wall Installation: Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure. Space studs as indicated; set plumb, align, and fasten both flanges of studs to track, unless otherwise indicated.
1. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 2. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 54 inches apart. Fasten at each stud intersection.

3. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.
- F. Joist Installation: Install, align, and securely anchor perimeter joist track sized to match joists as indicated on Shop Drawings. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten to both flanges of joist track.
1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches. Reinforce ends and bearing points of joists as indicated on Shop Drawings.
 2. Space joists not more than 2 inches from abutting walls and at spacings indicated.
 3. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
 4. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated. Install web stiffeners to transfer axial loads of walls above.
 5. Install bridging at each end of joists and at intervals indicated. Fasten bridging at each joist intersection as indicated.
 6. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
 7. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.
- G. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

3.02 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.
1. Field and shop welds will be subject to testing and inspection.
 2. Remove and replace Work that does not comply with specified requirements.
 3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items.
- B. Steel framing and supports for applications where framing and supports are not specified in other sections.
- C. Shop Fabricated metal ladders.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.
- D. Section 05 12 13 - Architecturally Exposed Structural Steel: Finish requirements of exposed metal items.
- E. Section 05 31 00 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- F. Section 05 51 00 - Metal Stairs.
- G. Section 05 52 13 - Pipe and Tube Railings.
- H. Section 09 91 13 - Exterior Painting: Paint finish.
- I. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- B. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012, Including July 2013 Errata.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
 - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
 - 1. Use 2012a as indicated in 2016 CBC Referenced Standards.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.

- I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
 - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- 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; 2015.
- L. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- M. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2016a.
- N. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- P. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2011).
- Q. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
 - 1. Use 2010 w/Errata as indicated in 2016 CBC Referenced Standards.
- S. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- T. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel; 2004.
- U. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- V. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- W. SSPC-SP 10 - Near-White Blast Cleaning; 2007.
- X. SSPC-SP-2 - Hand Tool Cleaning; 2018.
- Y. SSPC-SP 3 - Power Tool Cleaning; 2018.
- Z. SSPC-SP 5 - White Metal Blast Cleaning; 2007.
- AA. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets on each ladder safety system product to be used, including installation instructions.
- 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. Certificate: Provide documentation that ladder safety system products of this section meet or exceed cited 29 CFR 1910.28, 29 CFR 1910.29, ANSI/ASSP Z359.16, and ANSI A14.3 requirements.
- E. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: 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."
- B. Coordination: Provide templates and sleeves for incorporation of embedded items into the Work specified in other Sections.
- C. Field-Verified Dimensions: Prior to fabrication, field verify dimensions and details of construction. Immediately report variances in writing to Construction Manager and Architect.
- D. Design indicated items under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in California.
- E. Fabricator's Qualifications: Fabricator of light structural steel framing members and other miscellaneous metal fabrications of structural character shall be approved by the authorities having jurisdiction in accordance with applicable Code provisions.
- F. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel or equal.
- G. Welder's Qualifications:
 1. 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.
 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.06 PACKAGING, DELIVERY, STORAGE AND HANDLING

- A. Storage, General: Store products in enclosed, well-ventilated spaces, not in contact with soil or vegetation and not subject to inclement weather.
- B. Delivery, Storage and Handling, Galvanized Products:
 1. Stack and bundle during transport and store to allow air flow between galvanized surfaces.
 2. Load for transport to permit continuous drainage should wetting occur.
 3. Do not rest galvanized products on cinders or clinkers.

1.07 PROJECT CONDITIONS

- A. Field Inspection of Fabricated Products: Prior to installation, inspect products for damage and verify markings and dimensions against reviewed submittals.
- B. Environmental Conditions: Do not install products intended for interior locations when spaces are uncovered and unprotected from inclement weather.
- C. Coordination: Coordinate metal fabrications Work with Work specified in other Sections so that related Work shall be accurately and properly joined.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: Steel plates, bars, angles, channels, and H-sections; ASTM A 36/A 36M.
 - 1. Galvanized Steel: Structural shapes, plates and bars: From fully killed or semi-killed steel, ASTM A992/A992M, except silicon content in the range 0 to 0.4 percent or 0.15 to 0.25 percent, as applicable, only.
- B. Steel Tubing: ASTM A500/A500M, Grade B cold-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Steel Sheet:
 - 1. For structural uses: Hot-rolled, ASTM A1011/A1011M; cold-rolled, ASTM A1008/A1008M.
 - 2. For nonstructural uses: Cold-rolled, ASTM A1008/A1008M; hot-rolled, ASTM A1011/A1011M.
 - 3. Galvanized Sheet steel: ASTM A653/A653M, with ASTM A924/A924M, Coating Designation G90, for precoated sheet; ASTM A1011/A1011M for sheet used in fabrications.
- E. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- F. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- G. Slotted Channel Fittings: ASTM A1011/A1011M.
- H. Fasteners: See Article Anchors, Fasteners and Accessory Materials below.
- I. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- J. Galvanizing: See requirements specified below.
- K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- L. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 ACCESSORIES

- A. Anchors and Fasteners, General: Same material, color and finish as the metal to which applied, unless otherwise indicated.

- B. Exterior Exposure: Provide stainless steel.
- C. Type, Size and Spacing: Unless otherwise indicated, provide fasteners of type, grade and class required for intended use and sized and spaced as required for loads and substrate.
- D. Screw Head, Typical: Unless otherwise noted, exposed screws shall be phillips oval or flat head, countersunk.
- E. Standard Bolts and Nuts, Steel: ASTM A307, Grade A, hexagonal head.
- F. Lag Screws and Bolts, Steel: ASME B18.2.1, type and grade best suited for the purpose, hexagonal or square head.
- G. Plain Steel Screws: FS FF-S-85, FS FF-S-92 and FS FF-S-111; type and grade best suited for the purpose.
- H. Self-Drilling Metal Screw Fasteners: TEKS by Buildex Division, Illinois Tool works, Inc.; ICC Report ESR-1976; www.itwbuildex.com.
- I. Plain Steel Washers: FS FF-W-92, round, carbon steel.
- J. Lock Washers: FS FF-W-84, helical spring, carbon steel.
- K. Fiber Plugs, Lead Expansion Shields and Screws: Not permitted.
- L. Anchors and/or Dowels Installed with Adhesives: See notes on Structural Drawings.
- M. Threaded Welded Stud Anchors: Nelson Stud Welding Division, TRW, Inc., or approved equal; type and size according to manufacturer's instructions and recommendations, except where otherwise indicated.
 - 1. Nelson Stud Welding, Inc. ; Nelson Shear Connector Studs (ICC Report ESR-2856); www.nelsonstud.com.
- N. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded.
- O. Shop Primer Paint:
 - 1. Shop primer, general: Coordinate primer with finish paint and coating, as applicable, to provide sound foundation for field-applied topcoats despite prolonged exposure during construction.
 - 2. Shop primer for ferrous metal at exposed exterior locations: Fabricator's standard zinc-rich two-part catalyzed epoxy coating.
 - 3. Shop primer for ferrous metal at concealed exterior locations and for interior locations: Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer, complying with performance requirements of FS TT-P-645.
 - 4. Shop primer for galvanized steel, for exposed exterior locations: Fabricator's standard two-part catalyzed epoxy coating, compatible with specified finish paints.
- P. Field Primer and Finish Paints: As specified in Section 09 91 23 - Interior Painting.
- Q. Bituminous Coating: High-build mineral-filled coal tar pitch coating, or a cold-applied asphalt mastic complying with ASTM D1187/D1187M, except containing no asbestos fibers.
 - 1. Basis of Design Product: H.B. Tnemecol Series 46-465 as manufactured by Tnemec, Inc., www.tnemec.com, or approved equal.
 - 2. Acceptable Manufacturers:
 - a. BASF (24 g/L).

- b. Chemmasters.
 - c. Euclid Chemical.
 - d. Henry.
 - e. Polyguard.
 - f. W.R. Meadows, Inc.; Seal matsic Type II (Brush-on/Spray Grade):
www.wrmeadows.com
- R. Bond Breaker Tape: Isolate dissimilar metals with Pecora 531 Bond Breaker Tape or equal.

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. Preparation Before Fabrication: Remove loose mill scale and rust and remove twists and bends in manners not injurious to materials and finishes.
- C. Fabrication: Fabricate and finish metal items in accordance with the Drawings and reviewed shop drawings.
1. Contractor shall verify measurements before fabrication.
 2. Galvanize all exterior steel members to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.
 3. 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.
 4. Fit and shop assemble items in largest practical sections, for delivery to site.
 5. Prepare and reinforce fabrications as required to receive applied items and transport to site.
- D. Cutting and Fitting: Fabricate with accurate angles and surfaces, true to the required lines and levels and as required to suit installation conditions.
1. Fabricate items with joints tightly fitted and secured.
 2. Continuously seal joined members by intermittent welds and plastic filler.
 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.
 4. Punch, drill and reaming in manner to leave clean, true lines and surfaces.
 - a. Oversize hole 1/16 inch by punching, when material thickness is equal to or less than bolt diameter plus 1/8 inch.
 - b. 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.

5. Gas cutting of non-structural steel items may be acceptable where stress is not transmitted through flame-cut surfaces.
 - a. Make cuts clean and to contour.
 - b. Deduct 1/8 inch from effective width of members cut by torch.
- E. 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.
- F. Bolted and Screwed Connections:
 1. Provide holes and connections for work specified in other Sections.
 2. Use bolts for field connections only.
 3. Provide washers under heads and nuts bearing on wood.
 4. Draw all nuts tight and nick threads of permanent connections.
 5. Use beveled washers where bearing is on sloped surfaces.
 6. 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.
- G. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- H. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- I. 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.
- J. Joints on Finished Surfaces: Provide welds ground smooth and filled.
- K. Joints Exposed to Weather or Water: Fabricate to keep water out, or provide adequate drainage of water that penetrates.
- L. 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.
- M. Coordination: Make provisions to connect metal fabrications with or to receive work specified in other Sections.

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.
 2. Fabricate items to sizes, shapes, and dimensions required. Provide malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.
- B. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
1. Provide roof access ladder, as indicated on Drawings, fabricated of steel bar sides and brackets, mounted to building wall, configured and dimensioned in conformance to OSHA Regulation 1910.27, with round bar stock rungs.
 - a. Hot-dip galvanize ladder all ladder components after fabrication.
 - b. Unless otherwise shown or required by governing authorities, fabricate ladder in accordance with NAAMM standards and recommended details.
 2. Side Rails: 3/8 x 3 inches members with eased edges, spaced at 24 inches.
 3. Rungs: one inch diameter solid round bar spaced 12 inches on center. Let rungs into side rails.
 - a. Provide 13 ga. three row non-slip surfaces on top of each rung mechanically pressure punched/stamped.
 - 1) Basis of Design Product: Buttonhole type as manufactured by McNichols Company, or approved equal.
 4. Space rungs 7 inches from wall surface.
 5. Anchor brackets:
 - a. As indicated on Drawings.
 - b. Angle: 3-1/4 by 7-1/4 inch by 2-1/2 inches wide;
 - c. Minimum two per stringer, maximum spacing 60 inches on center and within 24 inches of unsupported or unanchored ends.
 6. Where indicated on Drawings, provide lockable standard door.
 - a. Top of door shall be cover the first rung to minimum 7 feet above finish floor unless indicated otherwise on Drawings.
 - b. Padlock, OFOI by District.
 7. Protective Cage: Cage as detailed for ladders over 20 feet high.
 8. Platform: Platform as detailed for ladders over 20 feet high.
- C. Ledge Angles Not Attached to Structural Framing: For support of metal decking; galvanized finish.
1. Drill plates to receive anchor bolts and for grouting as required.
- D. Frames for Wall Openings: Channel and Angle sections; prime paint finish.
- E. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.
- F. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
- G. Enclosure Gates

1. Fabricated steel shapes as detailed on Drawings, hot-dipped galvanized finish after fabrication, with galvanized perforated steel panel infill.
 2. All welded construction.
 3. Hardware: Welded on heavy duty butt hinges, minimum 4-hinges per leaf, latch device mounted 40 inches above finish surface and including padlock eye, drop rod with steel pipe receivers cast into concrete at both open and closed positions (both leafs).
 4. At Pedestrian Gate: Provide 16 gage steel sheet kick plate on push side of gate up to a minimum of 10 inches above finish surface.
 - a. Connect kick plates with a 16 gage closure placed on top of kick plates; from front to back plates and side to side. Overlap to outside on top of kick plates a minimum 1/2 inch. Tack or spot weld as required.
 - b. Kick plate to have drain holes in back face to minimize collection of water in bottom of angle frame.
- H. 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.

2.05 FINISHES - STEEL

- A. Prime paint all steel items. Conform to SSPC Painting Manual. Shop primer paint after fabrication all metal fabrications.
 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.
 3. Exceptions:
 - a. Do not prime stainless steel, plated steel, and anodized aluminum fabrications, unless specifically noted.
 - b. Do not shop prime galvanized fabrications, unless specifically noted.
 - c. Do not shop prime fabrications for which an entirely field-applied coating system is indicated.
- B. Prepare surfaces to be primed in accordance with minimum SSPC-SP2.
 1. Exterior fabrications: Clean in accordance with SSPC-SP 5, SSPC-SP 6, 8, or SSPC-SP 10.
 2. Interior fabrications: Clean in accordance with SSPC-SP 2, SSPC-SP 3, SSPC-SP 5, SSPC-SP 6, 8, or SSPC-SP 10.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat where finish painting is to be applied.
 1. Shop Priming: Comply with SSPC-PA 1. Coordinate with requirements specified in Section 09 91 23 - Interior Painting .
 - 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.
 - 2) Tnemec Series V10, or approved equal, modified alkyd rust-inhibitive primer, or manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer, complying with performance requirements of FS TT-P-645.
 - b. Apply primer immediately following surface preparation.
 - c. Do not prime surfaces to be welded.
 - d. Do not prime surfaces in direct contact bond with concrete or mortar.
 - e. Spray apply shop prime without holidays, drips, runs.
 - f. Provide two coats where product is not to be finish painted or is to be concealed in completed work.
 - g. Apply an additional coat to corners, welds, edges, and fasteners.
 - h. Allow primer to dry and cure before handling.
- E. Shop Painting
1. Shop Painting: Comply with SSPC-PA 1. Shop paint fabrications where feasible.
 - a. Apply thermosetting enamel paint, gloss or semi-gloss, of a type and color as selected and approved by Architect, if not otherwise specified.
 - b. Shop applied finish paint shall be baked to set and cure.
 - c. Allow finish paint to thoroughly dry and cure before handling.
 2. Steel Embedded in Concrete: Coat concealed faces with bituminous coating.
 3. Galvanized Pre-Treatment: Where zinc-coated surfaces are specified to be shop primed, chemically treat surfaces to provide bond for paint before applying primer.
- F. Galvanizing of All Exterior Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- G. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

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. Obtain Architect's review prior to site cutting or making adjustments not indicated on Drawings and reviewed shop drawings.
- B. Clean and strip primed steel items to bare metal where site welding is required.
- C. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.
- D. Make provision for erection loads with temporary bracing. Keep work in alignment.
- E. Clean and prime field welds. Touch up galvanized steel with cold galvanizing compound.

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 or galvanized, except surfaces to be in contact with concrete.

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.

3.05 CLEANING AND TOUCH-UP

- A. Cleaning: Perform initial cleaning immediately after completion of installation. Prepare surfaces for finish painting.
- B. Galvanizing Touch-Up: Touch up galvanizing immediately after installation, including field welding.
 - 1. Prepare surface and apply cold galvanizing compound in compliance with ASTM A780/A780M and the manufacturer's instructions and recommendations.
- C. Primer Paint Touch-Up: Touch up shop paint immediately after erection. Use products compliant with Section(s) 09 91 13 - Exterior Painting and 09 91 23 - Interior Painting.
 - 1. Clean exposed areas of rust, field welds, bolted joints, and areas where primer is damaged by SSPC-SP 2 hand tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Paint with SSPC-Paint 15 (interior) or SSPC-Paint 20 (exterior) compliant material used for shop painting, minimum 3 mils dry film thickness.

END OF SECTION

SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete fill in stair pans and landings; mesh reinforcement for landings.
- B. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal anchors in concrete.
- C. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
- D. Section 05 50 00 - Metal Fabrications.
- E. Section 05 52 13 - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.
- F. Section 05 52 13 - Pipe and Tube Railings: Metal handrails and balusters other than specified in this section.
- G. Section 09 91 13 - Exterior Painting: Paint finish.
- H. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2016.
 - 1. Use 2011 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
 - 1. Use 2008 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
 - 1. Use 2009 as indicated in 2016 CBC Referenced Standards.
- H. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
 - 1. Use 2012a as indicated in 2016 CBC Ch. 35 Referenced Standards.

- I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- J. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- K. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- L. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- 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; 2015.
- N. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
 - 1. Use 2010 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- R. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- T. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- U. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- V. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.
 - 1. Use 2004 as indicated in 2016 CBC Ch. 35 Referenced Standards.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.
- E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- B. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
- C. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 - 1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 - a. 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 demonstrating a coefficient of friction of at least 0.6 per ASTM C1028 will be accepted as meeting the intent of slip resistance; CBC 11B-302.1, 11B-504.4, and 11B-504.7.
 - 2) Provide minimum 2-inch contrasting color (70% recommended) warning stripe of material at least as slip resistant as the other treads of the stairs, 1-inch maximum from edge of nosing and top landing. CBC 11B-5041.4.
 - (a) At exterior stairs, provide warning stripe at top landing and all tread nosings.
 - b. Treads, Risers, and Nosings: CBC Section 11B-504
 - 1) Interior stairs shall have the upper approach and lower tread of each flight marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
 - 2) The stripe providing clear visual contrast shall be a minimum of 2 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 .
- c. Conform to California Building Code (CBC), Title 24, Part 2, Section 11B-505 as amended and adopted by authorities having jurisdiction.
 - 1) Height: The top of the handrail grasping surface shall be mounted between 34 to 38 inches above the nosing of the treads or the ramp surface. CBC 11B-505.4.
 - 2) Gripping Surface:
 - (a) The circular Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1¼ inches (32 mm) minimum and 2 inches (51 mm) maximum; CBC 11B-505.7. Cross sectional nominal dimension is outside diameter not pipe size.
 - (b) Handrail projecting from a wall shall have a space of 1-1/2 inch (38 mm) between the wall and the handrail. CBC 11B-505.5.
 - (c) Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges. CBC 11B-505.8.
 - 3) Wheel guide rails or guide curbs shall provide a continuous and uninterrupted barrier along the length of a ramp. CBC 11B-405.9, 11B-405.9.2 and Figure 11B-405.9.2.
2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
3. Dimensions: As indicated on drawings.
4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
 2. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
 - a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
 - b. Welds Exposed to View: Ground smooth and flush.
 - c. Mechanical Joints: Butted tight, flush, and hairline.
 - d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.

- e. Exposed Edges and Corners: Eased to small uniform radius.
 - f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
 - D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Commercial, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
 - 1. Concrete Depth: 1-1/2 inches, minimum.
 - 2. Tread Pan Material: Steel sheet.
 - 3. Tread Pan Thickness: As required by design; 12 gage, 12 inch minimum.
 - 4. Factory Fabricated Tread and Nosing: Manufacturer's standard, field applied aluminum walking surface with integral nosing, abrasive filler and factory applied finishes.
 - 5. Pan Anchorage to Stringers: Welded to carrier angles welded to stringers.
 - 6. Concrete Reinforcement: Welded wire mesh.
 - 7. Concrete Finish: Steel troweled.
- D. Risers: Same material and thickness as tread pans.
 - 1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
 - 2. Nosing Depth: Not more than 1-1/2 inch overhang.
 - 3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
 - a. Coordinate with tread nosing.
 - 4. Applied Nosings and visually impaired strips: See Accessories.
- E. Stringers: Rolled steel channels.
 - 1. Stringer Depth: As indicated on drawings.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: Similar construction, using corrugated steel decking, supported and reinforced as required to achieve design load capacity.
- G. Finish: Galvanized after fabrication, except sheet components to be galvanized before fabrication.
 - 1. Where indicated, finish paint with High-Performance coating, see Section 09 96 00 - High-Performance Coatings.
- H. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.03 HANDRAILS AND GUARDS

- A. Wall-Mounted Rails: As specified in Section 05 52 13.

- B. Guards: Pipe railings as specified in Section 05 52 13.
- C. Guards: Pipe railings as specified in Section 05 70 00 - Decorative Metal.

2.04 MATERIALS

- A. Steel Sections: ASTM A36/A36M and ASTM A992/A992M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
- D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- E. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- F. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 with G90/Z275 coating.
- G. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.
- H. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.05 ACCESSORIES

- A. Factory Fabricated Stair Tread and Nosing:
 - 1. Materials: Extruded aluminum, alloy type 6063-T5, mill finish.
 - a. Tread Abrasive Filler: Virgin grain aluminum oxide epoxy-bonded to tread base.
 - b. Tread Type: Ribbed bar.
 - c. Nosing Types: Angled long nose for sloped stairs.
 - d. Color: Safety Yellow.
 - 2. Basis of Design Product: BSTSB-A3E as manufactured by Babcock-Davis, www.babcockdavis.com, or approved equal.
 - 3. Acceptable Manufacturers:
 - a. American Safety Tread Co. Inc.: www.americansafetytread.com.
 - b. Nystrom, Inc: www.nystrom.com.
 - c. Wooster Products, Inc.: www.wooster-products.com.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Photoluminescent Handrail Strips: Manufacturer's standard clear anodized aluminum extrusion with embedded photoluminescent strip, complies with UL 1994.
 - 1. Attachment: Provide manufacturer approved field applied adhesive, factory applied adhesive, and mechanical fasteners.
- C. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

- E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.06 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
 - 2. Number of Coats: One.
- D. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 - 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- H. Nosing Installation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Interface With Other Work:

- a. Safety nosings going into new poured concrete or cement fill shall be installed before "Initial Set" of the concrete or cement occurs.
- b. Nosings shall finish flush and level with the top of the traffic surface.

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. Nosings:
 1. Maximum Variation From True Position: 1/8-inch.
 2. Maximum Offset From True Alignment: 1/8-inch.

3.05 CLEANING

- A. Clean all concrete splash and dust for an as new look prior to Final Acceptance.

3.06 PROTECTION

- A. Protect installed color filled tread nosings from subsequent construction operations.
- B. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings at steps or ramps.
- D. Balcony railings and guardrails.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 05 05 19 - Post-Installed Concrete Anchors: Placement of anchors in concrete.
- C. Section 05 12 13 - Architecturally Exposed Structural Steel: Finish painting of exposed metal items.
- D. Section 05 50 00 - Metal Fabrications: Embedded items, welding and shop painting.
- E. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this section.
- F. Section 05 51 00 - Metal Stairs: Attachment plates for handrails specified in this section.
- G. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.
- H. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- G. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.
- H. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

- J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- L. NAAMM AMP 521 - Pipe Railing Systems Manual; 2001 (reaffirmed 2012).
- M. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel; 2004.
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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 shall 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. Samples: Submit two, 8 inch long samples of handrail. Submit two samples of infill panel.
- D. Fabricator's Qualification Statement.
- E. Sustainable Submittals:
 - 1. Submit applicable LEED Submittal Form for each different product or component which contains recycled content.
 - 2. Laboratory Test Reports: For primers, documentation indicating that products 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."

1.05 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in California, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

1.06 QUALITY ASSURANCE

- A. Welder's Qualifications: Welding shall be performed by certified welders qualified in accordance with procedures specified in AWS D1.1/D1.1M, using materials, procedures and equipment of the type required for this work.
- B. Coordination: Provide templates and sleeves for incorporation of embedded items into the work specified elsewhere herein.

1.07 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 ASTM E985 and applicable local code.
- C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E 935.
- D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E 935.
 - 1. Infill Area and Intermediate Rails: Resist a minimum horizontal concentrated load of 200 LBF applied to one square foot at any point in the system, including panels, intermediate rails balusters, or other elements composing the infill area.
- E. Allow for expansion and contraction of members and building movement without damage to connections or members.
- F. 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.
- G. 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 stud walls, provide backing plates, for bolting anchors.
- H. 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.

2.02 RECYCLE CONTENT OF STEEL:

- A. Provide an average recycled content of postconsumer plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 70 percent.
 - 2. Channels, Angles, M-Shapes, and S-Shapes-Shapes: 70 percent.
 - 3. Plate and Bar: 70 percent.
 - 4. Cold-Formed Hollow Structural Sections: 70 percent.
 - 5. Steel Pipe: 70 percent.
 - 6. All Other Steel Materials: 70 percent.

2.03 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.
 - 1. Welding Rods: Series E70, conforming to AWS D1.1/D1.1M.
- 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.

2.04 ANCHORS, FASTENERS AND ACCESSORY MATERIALS

- A. Exposed Anchors and Fasteners: Same material, color and finish as the metal to which applied.
- B. Type, Size and Spacing: Unless otherwise indicated, provide fasteners of type, grade and class required for intended use and sized and spaced as required for loads and substrate.
- C. Screw Head, Typical: Unless otherwise noted, exposed screws shall be phillips oval or flat head, countersunk.
- D. Standard Bolts and Nuts, Steel: ASTM A307, Grade A, hexagonal head.
- E. Plain Steel Screws: FS FF-S-85, FS FF-S-92 and FS FF-S-111; type and grade best suited for the purpose.
- F. Plain Steel Washers: FS FF-W-92, round, carbon steel.
- G. Lock Washers: FS FF-W-84, helical spring, carbon steel.
- H. Concrete Anchors: As specified in Section 05 12 13 - Architecturally Exposed Structural Steel.
- I. Grout: As specified in Section 03 30 00 - Cast-in-Place Concrete.
- J. Handrail Wall Brackets: Cast steel type or profile as detailed on Drawings.

2.05 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.
 - 1. Internal Stiffeners: Cast iron, malleable iron, pipe or tube. Fit snugly.
 - 2. Dimensions, Spacing and Configuration: As shown on Drawings and as specified herein.
 - a. Top Rails: Run continuously over posts, level and not less than minimum height indicated on the Drawings and required by California Building Code (CBC).

- b. Vertical Members: Lay out as shown, evenly spacing verticals in each run. Where two runs are adjacent to each other, align verticals on each side. Set posts as required for design requirements and a maximum of 60 inches on center. Fabricate verticals for plumb and true installation.
 - c. Bottom Railing: Parallel to top rail and with floor surface or stair stringer, as applicable.
 - d. Alignment: Centerline of members within each railing run shall be in same vertical plane.
3. Cutting and Fitting:
- a. Power cut throughout; gas cutting not permitted at joint. Gas cutting may be used if not closer than 6 inches from actual joint.
 - b. Cope to fit intersecting members. Bevel ends to receive full fillet weld.
 - c. Provide corners neatly coped, welded and ground.
 - d. Provide connections with fittings or, at Contractor's option, neatly coped, welded and ground.
4. Fabrication:
- a. Fabricate railings in largest practicable sections to minimize field joints.
 - b. Fabricate rails in true, straight alignment.
 - c. Provide for field-welded joints. Fabricate to hairline tolerances before welding.
 - d. Grind projections, terminations and edges smooth.
 - e. Provide closures on exposed ends.
 - f. Do not use exposed fastening plates except as specifically detailed. Use concealed plug or direct welding as applicable.
5. Welding: Provide backup or stiffeners at joints to hold joint in perfect alignment during welding. Weld all around joint. Grind all welds smooth and dressed, without sharp or abrasive corners, edges or surfaces.
- 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 intermittent welds and plastic filler.
 - 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).

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 fabrication and installation of steel pipe and tube railings so that related Work accurately and properly joins.

3.02 PREPARATION

- A. Obtain Architect's review prior to site cutting or making adjustments not indicated on shop drawings.
- B. Clean and strip primed steel items to bare metal where site welding is required.
- C. Supply items required to be cast into concrete or embedded in masonry 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.
- 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.
 - 4. Secure railing to bracket with pre-drilled hole for exposed bolt anchorage.
 - 5. Securing Railings to Concrete Walls as Applicable: Anchor railings to concrete substrate with expansion anchors as specified in Section 05 12 13 - Architecturally Exposed Structural Steel.
 - a. Railing intermediate supports: Secure to wall with specified handrail brackets.

- 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.
- 6. Securing Railings to Metal Stud Framed Walls: Anchor brackets and fittings directly to steel framing or to concealed sheet steel backing or to concealed anchors, using self-tapping screws of size and type necessary to support structural loads.
- I. Securing Railings to Steel Stringers and Other Steel Supports:
 - 1. Anchor posts by butt welding to steel member. Clean and dress welds. Apply primer paint for corrosion protection.
 - 2. Install removable railing sections where indicated in slip-fit metal sockets welded exposed steel framing. Accurately locate sockets to match post spacing.
- J. Securing Roof Hatch Railing to Roof: Through-bolt to roof deck. Coordinate stripping in with Division 7 Roofing Section.

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 05 70 00
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Railing and guardrail assemblies.
- B. Wall-mounted handrails.
- C. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Supports.
- B. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this section.
- C. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- E. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2016.
- F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- G. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- H. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
 - 1. Use 2010 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
 - 1. Contractor.
 - 2. Manufacturer's representative.
 - 3. Architect.
 - 4. District's representative.

5. Other subcontractors of adjacent work.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
- C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
- D. Samples: Submit one (1) of each item below for each type and condition shown.
 1. Railing: 12 inch long section of handrail illustrating color, finish and connection detail.
- E. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
- F. Manufacturer's Installation Instructions.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing decorative stairs and railing systems and acceptable to manufacturer.
- B. Templates: Supply installation templates, reinforcing and required anchorage devices.

1.07 MOCK-UP

- A. Provide mock-up of stair, railing system, freestanding center rail, wall-mounted handrail, and guardrail, 6 feet long by 8 feet wide, illustrating each type of material, cladding, and finish.
- B. See Section 01 45 00 - Quality Control for additional requirements.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover, in a dry location.

1.09 FIELD CONDITIONS

- A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F and maximum 95 degrees F.

- B. Maintain ambient temperature of space at minimum 65 degrees F and maximum 95 degrees F for 24 hours before, during, and after railing installation.

1.10 WARRANTY

- A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 RAILING SYSTEMS

- A. Regulatory Requirements: Conform to California Building Code (CBC), Title 24, Part 2, Section 11B-505.6-8 and 11B-405.8 as amended and adopted by authorities having jurisdiction.
 - 1. The top of the handrail grasping surface shall be mounted between 34 to 38 inches above the walking surfaces, nosing of the treads, or the ramp surface. CBC 11B-505.4.
 - 2. 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 percent of their length. Where provided, horizontal projections shall occur 1½ inches (38 mm) minimum below the bottom of the handrail gripping surface. CBC Section 11B-505.6-8.
 - a. Handrail gripping surfaces shall have a cross section complying with CBC Section 11B-505.7.1 or 11B-505.7.2.
 - b. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges. CBC Section 11B-505.8.
 - 3. Wheel guide rails or guide curbs shall provide a continuous and uninterrupted barrier along the length of a ramp. CBC Section 11B-405.9, 11B-405.9.2 and Figure 11B-405.9.2.
- B. Railing Systems - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
 - 1. Performance Requirements: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
 - a. Lateral Force: 75 lb minimum, at any point, when tested in accordance with ASTM E935.
 - b. Distributed Load: 50 lb/ft minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.
 - c. Concentrated Loads on Intermediate Rails: 50 psf, minimum.
 - d. Concentrated Load: 200 lbs minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
 - e. Handrails: Comply with applicable accessibility requirements of ADA Standards.
 - 2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
 - 3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
 - 4. Field Connections: Provide sleeves to accommodate site assembly and installation.

5. Welded and Brazed Joints: Make exposed joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
 - a. Ease exposed edges to small uniform radius.
 - b. Welded Joints:
 - 1) Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
- C. Metal Tube Railing: Engineered, post supported railing system with metal infill.
 1. Configuration: Guardrail with separate handrail.
 2. Grip Rail: Round, stainless steel, 1-1/2 inch diameter.
 3. Decorative Flanges for Embedded Posts: Circular, collared cover plate without screw holes.
 4. Wall Mounted Components: Components necessary to support railing with 1-1/2 inch clearance from wall, and as follows:
 - a. Underslung support brackets: Supports at 60 inches, maximum.
 - b. Wall return without support: Terminates 1/4 inch from side wall.
 5. Handrail Brackets: Same metal as railing.
 6. Fasteners: Concealed.
 7. Infill at Mesh Railings: Metal mesh panels.
 - a. Metal Infill Panels: Welded wire mesh; stainless steel wire in panels with manufacturer's standard edge and factory applied coating.
 - 1) Basis of Design Product: Omega 1500 as manufactured by GKD Metal Fabrics, or approved equal.
 8. End and Intermediate Posts: As shown on drawings.
 - a. Horizontal Spacing: As indicated on drawings.
 - b. Mounting: Welded.
- D. Wall-Mounted Handrail:
 1. 1-1/2 inch diameter stainless steel; No. 4 bright finish (brushed).
 2. Handrail Brackets: Manufacturer's standard steel brackets.
 - a. Mounting: Wall.
 - b. Finish: No. 4 bright finish (brushed).
 3. Comply with CBC 11B and ADA Standards.
 4. Basis of Design: C.R. Laurence Company, Inc; HRS Hand Railing Systems: www.crl-arch.com/#sle.

2.02 MATERIALS

- A. Steel Components:
 1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
 2. Tubing: ASTM A500/A500M structural tubing, round and shapes as indicated.
- B. Stainless Steel Components:
 1. ASTM A666, Type 316.

2. Stainless Steel Tubing: ASTM A554, Type 304, 16 gage, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
3. Stainless Steel Finish: No. 4 Bright Polished finish.
4. Basis of Design: C.R. Laurence Company, Inc; HRS Hand Railing Systems: www.crl-arch.com/#sle.

2.03 ACCESSORIES

- A. Non-Weld Mechanical Fittings for Stainless Steel Railings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
- C. Anchors and Fasteners: Provide anchors and other materials 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 bolting anchors.
 2. For anchorage to masonry, provide brackets to be embedded in masonry for bolting anchors.
 3. For anchorage to stud walls, provide backing plates for bolting anchors.
 4. Exposed Fasteners: No exposed bolts or screws.
- D. Carbon Steel Bolts and Nuts: ASTM A307.
- E. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch dry film thickness per coat.
- F. Sealant: Silicone; black.
- G. Finish Touch-Up Materials: As recommended by manufacturer for field application.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

- A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
- B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. 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.
- F. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

3.05 FIELD QUALITY CONTROL

- A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

3.07 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.

1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Communications and electrical room mounting boards.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
 - 1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- C. PS 1 - Structural Plywood; 2009.
- D. PS 20 - American Softwood Lumber Standard; 2010.
 - 1. Use 2005 as indicated in 2016 CBC Referenced Standards.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

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.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 3. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.03 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
- B. Water-Resistive Barrier: As specified in Section 07 25 00.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top

story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

1. Comply with CBC Section 718.2 Fireblocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

3.03 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.
 4. Size and Location: As indicated on drawings.

3.04 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.05 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, for additional requirements.

3.07 CLEANING

- A. Waste Disposal:
1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

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 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 08 14 16 - Flush Wood Doors.
- D. Section 06 41 00 - Architectural Wood Casework: Cabinet hardware.
- E. Section 09 91 23 - Interior Painting: Painting of finish carpentry items.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- B. ANSI A208.1 - American National Standard for Particleboard; 2009.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- E. AWP A U1 - Use Category System: User Specification for Treated Wood; 2012.
 - 1. Use 2014 as indicated in 2016 CBC Ch. 5 Referenced Standards.
- F. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.
 - 1. Use 2013 as indicated in 2016 CBC Ch. 5 Referenced Standards.
- H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- I. PS 1 - Structural Plywood; 2009.
- J. WDMA I.S. 4 - Industry Specification for Preservative Treatment for Millwork; 2013.
- K. WI (MCP) - Monitored Compliance Program (MCP); current edition at www.woodworkinstitute.com.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.

- B. Product Data:
 - 1. 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 finish plywood, 6 by 8 inch in size illustrating wood grain and specified finish.
- E. Samples: Submit two samples of wood trim 6 inch long.
- F. 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. 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 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect work 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: Clear white Maple; prepare for paint finish.
2. Loose Shelving: Birch plywood; prepare for paint finish.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood, certified or labeled as specified in Section 01 63 00 - Product Substitution Procedures.
- C. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless indicated otherwise, and provided it is clean and free of contamination, identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc. (ALSC).

2.03 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, medium density fiberboard 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 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.

2.05 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 indicated on Drawings.

2.06 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Concealed Joint Fasteners: Threaded steel.

2.07 ACCESSORIES

- A. Lumber for Shimming and Blocking: Softwood lumber of indicated species.
- B. Primer: Alkyd primer sealer.
- C. Wood Filler: Oil base, tinted to match surface finish color.

2.08 HARDWARE

- A. Hardware: Comply with BHMA A156.9.

2.09 WOOD TREATMENT

- A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Wood Preservative by Pressure Treatment (PT Type): Provide AWPA U1 treatment using waterborne preservative with 0.25 percent retainage.
- C. Water Repellent Preservative Treatment by Dipping Method: WDMA I.S. 4, with 0.25 percent retainage.
- D. Wood Preservative (Surface Application): Clear, Wodlife Classic type, Tris-2,4,6-(Dimethylaminomethyl) Phenol manufactured by Rust-Oleum Corporation.
- E. Shop pressure treat wood materials requiring preservatives to concealed wood blocking.
- F. Redry wood after pressure treatment to maximum 19 percent moisture content.

2.10 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- 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 AWI/AWMAC/WI (AWS) or 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.
- 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.
- B. 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. 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 hardware in accordance with manufacturer's written instructions.

3.03 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Brush apply one coats of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.04 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 91 23.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.05 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.
- B. Cabinet hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Project Type:
 - 1. Public
- B. Code agency:
 - 1. California Building Code
 - 2. DSA
- C. Section 06 20 00 - Finish Carpentry: Wood trim unrelated to casework.
- D. Section 08 80 00 - Glazing: Glass for casework.
- E. Section 09 21 16 - Gypsum Board Assemblies: Support framing, grounds, and concealed blocking.
- F. Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- E. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- F. WI (MCP) - Monitored Compliance Program (MCP); current edition at www.woodworkinstitute.com.

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 33 00 - Submittal Procedures, 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 AWMAC/WI (NAAWS).
3. Include certification program label.
 - a. Affix a Woodwork Institute Certified Compliance Label WI (CCP) on the first page of the shop drawings.
- 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. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.

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.
 3. A Licensee of the Woodwork Institute's Certified Compliance Program.
- B. Quality Certification: Provide WI (MCP) inspection report and quality certification of completed work.
 1. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 3. Certified Seismic Casework Installation:
 - a. 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.
 - b. All casework installation shall be certified by the Woodwork Institute in accordance with their Certified Seismic Installation Program (CSIP) and their DSA Pre-approvals, including:
 - 1) A CSIP Certificate indicating that all of the casework installation fully meets the requirements of the AWS, CSIP and WI's OSHPD Pre-approvals.

- c. It is the responsibility of the installer to include within their bid, any and all costs for WI's CSIP certification. Certification is a prerequisite for final acceptance. For further information, please visit www.woodworkinstitute.com
- 4. Provide designated labels on shop drawings as required by certification program.
- 5. 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.
- 6. 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.
- 7. 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.
- 8. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UP

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. See Section 01 45 00 - Quality Control for additional requirements.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work, if approved.

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-0092-13.

- B. Requirements for Physically Disabled: Provide products meeting requirements of California Code of Regulations (CCR), Title 24, Part 2, Chapter 11B and ADA Accessibility Guidelines for Buildings and Facilities, latest amendment.
 - 1. Operable parts for all accessible casework shall comply with CBC Section 11B-309 Operable Parts.
 - 2. Pull hardware shall be U-shaped wire pulls or equally accessible at all accessible casework; CBC 11B-811.4 Operable Parts.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
 - 1. Storage, Janitor Closet, and/or Utility Room cabinets shall be built in conformance to Custom Grade.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Exposed Interior Surfaces: Solid phenolic.
 - 3. Finish - Semi-Exposed Surfaces: Solid phenolic
 - 4. Finish - Concealed Surfaces: Manufacturer's option. All surfaces to be sealed against checking.
 - 5. Finish - Semi-Exposed Surfaces: Cabinet interiors (other than exposed interior surfaces of open or glass front cabinets) including faces of shelving therein, and interior door faces: Finish with cabinet liner as specified herein, color as selected by the Architect.
 - 6. Shelf, Door, Drawer Front and False 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: 3mm purified PVC edge band, color and pattern to match exposed laminate, hot-melt applied.
 - c. All other exposed and semi exposed edges: 1mm PVC edge band, color and pattern to match exposed laminate.
 - 7. Door and Drawer Front Retention Profiles: Fixed panel.
 - 8. Casework Construction Type: Type A - Frameless.
 - 9. Interface Style for Cabinet and Door: Style 1 - Overlay; flush 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.
 - 10. Patterned Face Layout for Cabinet and Door Fronts: Style and Rail, all Grades.
 - a. Drawer fronts run grain either vertically or horizontally at the manufacturer's option.
 - b. Doors: Vertical grain.
 - 11. 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.
- 12. Cabinet Design Series: As indicated on drawings.
 - a. Base Cabinets without drawers: 100 series.
 - b. Base Cabinets with drawers: 200 series.
 - c. Wall hung Cabinets: 300 series.
 - d. Tall Storage Cabinets: 400 series.
 - e. Wardrobe Cabinets: 500 series.
 - f. Library Cabinets: 600 series.
- 13. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
- 14. Cabinet Style: Flush overlay.
- 15. Cabinet Doors and Drawer Fronts: Flush style.
- 16. Drawer Side Construction: Manufacturer's option.
- 17. Drawer Construction Technique: As recommended by fabricator.
- 18. Toe Kick Base: Resilient base at toe kick provided under Section 09 65 00 - Resilient Flooring.

2.03 WOOD-BASED COMPONENTS

- A. Lumber shall be sound, kiln dried softwood and/or hardwood meeting the requirements of the AWS Grade specified for its intended purpose.
- B. Panels shall contain no added urea-formaldehyde resins and shall be in accordance with the AWS requirements for the grade specified.
 - 1. Veneer: HPVA grade to meet the NAAWS requirements for type of surface and grade.
 - 2. Core: Comply with NAAWS.
 - a. Material: Combination Core, PureBond Classic Core, www.columbiaforestproducts.com, or equal.

2.04 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Abet - Laminati: www.abetlaminati.com
 - 2. Chemetal: www.chemetal.com.
 - 3. Formica Corporation: www.formica.com/#sle.
 - 4. Lamin-Art: www.laminart.com.
 - 5. Panolam Industries International, Inc; Nevamar: www.nevamar.com.
 - 6. Panolam Industries International, Inc\Pionite: www.pionite.com.
 - 7. Wilsonart LLC: www.wilsonart.com/#sle.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, color as selected, finish as scheduled.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, color as selected, finish as scheduled.
3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, color as selected, finish as indicated.
4. Post-Formed Vertical Surfaces: VGP, 0.028 inch nominal thickness, color as selected, finish as indicated.
5. Cabinet Liner: CLS, 0.020 inch nominal thickness, color as selected, finish as scheduled.
 - a. Low Pressure Decorative Laminate: color as selected by Architect from the manufacturers full range, melamine surfacing.
6. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.05 COUNTERTOPS

- A. Countertops are specified in Section 12 36 00.

2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
 1. Urea Formaldehyde adhesives shall not be used.
 2. Contact cement shall have a VOC content of less than 80 g/l.
 3. Construction adhesive shall have a VOC content compliant with CalGreen.
- B. Trim: Stainless steel, ASTM A666 type 304 or 316, brushed no. 4 finish. Brush grain to run in the long direction of the trim piece.
- C. Fasteners: Size and type to suit application.
- D. 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.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic, painted metal, or stainless steel / chrome plated grommets for cut-outs, in color to match adjacent surface.
 1. Basis of Design Product: TG Flip-Top® Series - 2" hole as manufactured by Doug Mocket & Company, Inc., or approved equal.
 - a. Application: desk, countertop, or worksurface grommets.
 - b. Hole Diameter: 2 inches.
 - c. Type: Flip Top.
 - d. Color as selected by Architect.
 - e. Location as directed by Architect or District. Final location and color to be indicated on shop drawing submittal.
 2. Basis of Design Product: TM12 - 12" Dia. x 1" Deep Stainless Steel Trash Grommet as manufactured by Doug Mocket & Company, Inc., or approved equal.

- a. Application: Countertop pass-through for trash.
- b. Hole Diameter: 12 inches.
- c. Type: Stainless steel trim ring.
- d. Location as directed by Architect or District. Final location to be indicated on shop drawing submittal.

2.07 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome or nickel finish, for nominal 1 inch spacing adjustments.
 - 1. Locking 3/4-inch plastic shelf supports for 5mm hole diameter.: Knap & Vogt Manufacturing Company; Product No. 339: www.knapeandvogt.com.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
 - 1. Comply with CBC 11B-811.4.
 - 2. Amerock: BP76312-G10, 4 inch Pull, Allison Value Hardware
 - 3. Rockler: Satin Nickel 4 inch Wire Pull.
 - 4. Top Knob: M338 - Wire Pull 4 inch - Brushed Satin Nickel - Somerset Collection
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
 - 1. Provide locks on all cabinet doors and drawers in classrooms, except accessible sink bases, and as follows:
 - a. A.V. Cabinets.
 - b. Tall Storage Cabinets.
 - c. Display Cabinets.
 - d. Filing Cabinets.
 - e. Workrooms to have locks on all doors and drawers.
 - 2. Locks for doors and drawers shall be keyed alike for each room and master keyed.
 - 3. Metal Strike Plates: Provide cabinet door and drawer locks with metal strike plates to protect against particle board rip out.
 - 4. 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.
 - 5. Locks shall be easily rekeyable pin tumbler with working top slide and retainer staple.
 - 6. Cabinet Locks:
 - a. Olympus Lock; Product 500DR: www.olympus-lock.com.
 - b. Corbin Cabinet Lock; Product 0737 Drawer Lock: www.cclsecurity.com.
 - 7. Drawer Locks:
 - a. Olympus Lock; Product 600DW: www.olympus-lock.com.
 - b. Corbin Cabinet Lock; Product 0738 Drawer Lock: www.cclsecurity.com.
- E. Catches: Magnetic.

1. 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. Stanley Architectural Hardware; Product CD46.
 2. 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.
- F. Drawer Slides:
1. Type: Full extension with 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.
 - 1) Drawer slide capacity with paper storage: 200 pounds.
 3. Mounting: Side mounted.
 4. Stops: Positive type.
 - a. Provide mechanical stops designed to prevent accidental removal of the drawer.
 5. Features: Provide self closing/stay closed type with rolling balls, steel rollers and self-lubricating bearings.
 6. Manufacturers:
 - a. Accuride International, Inc: www accuride.com/#sle.
 - b. Grant Hardware Company, Division of Hettich International: www.hettichamerica.com.
 - c. Hettich America, LP: www.hettich.com/sle.
 - d. Knappe & Vogt Manufacturing Company: www.knappeandvogt.com/#sle.
- G. Hinges: Semiconcealed type, BHMA No. B01521-3, steel with satin finish.
1. Provide two hinges for doors up to 48 inches in height. Provide minimum three hinges for doors over 48 inches in height. Comply with WI certification requirements.
 2. Wrap around style offset for overlay doors with non-removable pin.
 3. Five- knuckle hinge.
 4. ANSI/BHMA A156.9 level: Grade 1.
 5. Manufacturers:
 - a. Hafele America Co.; : www.hafele.com.
 - b. Hettich America, LP: www.hettich.com/sle.
 - c. Stanley Hardware Div.; Product No. 1592: www.stanleycommercialhardware.com.
- H. Bottom Rolling Glass Doors in front of casework outside classrooms: See Details.

2.08 SHOP TREATMENT OF WOOD MATERIALS

- A. Provide UL (DIR) listed and approved identification on fire retardant treated material.
- B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.09 SITE FINISHING MATERIALS

- A. Stain, Shellac, 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. Seal cut edges.
- G. Shop glaze glass materials using the Interior Dry method as specified in Section 08 80 00.

2.11 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D. 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: Flat.
 - 2. Opaque:
 - a. System - 12, Polyurethane, Water-based.
 - b. Color: As selected by Architect.
 - c. Sheen: Flat.

- E. Site applied stains and finishes shall comply with the requirements of SCAQMD
 - 1. All such products shall meet the VOC content requirements in the applicable category of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings (current version).

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. Provide a WI Certified Compliance Certificate for installation as specified herein.
 - 2. Install in accordance and comply with WI Certified Seismic Installation Program (CSIP).
- 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 24 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 Division of the State Architect 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.
 - 1. Secure to ground, stripping, blocking with countersunk, concealed fasteners.
- 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. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.
 - 1. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.04 CLEANING

- A. Take necessary action to keep this work clean and free of dirt, trash, obstruction and equipment, except that necessary for the proper completion of this work. Remove materials not used.
- B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 64 60
TRANSLUCENT RESIN PANEL SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the Plastic Fabrication as shown and specified in the described system(s):
 - 1. Privacy Screens (DWP-1)
- B. The extent of Solid Polymer Fabrication is shown on the drawings.
 - 1. Additional fabrication and installation details can be found on the 3form Partner Preliminary Project Review, if applicable

1.02 REFERENCE STANDARDS

- A. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.
- B. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics; 2016.
- C. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Project Pre-installation Meeting
 - 1. Owner, Architect, Contractor, Installer to meet at project site within one week of scheduled installation.
 - 2. Review mounting conditions, installation and storage instructions, fabrication requirements, seaming and protection measures.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 - Submittal Procedures.
- B. Product List: Minimum of 3 completed 3form Chroma installations or 3 installations of similar materials and complexity. Include contact name and email address for each product.
- C. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.
- D. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.
 - 1. Test reports required are:
 - a. Rate of Burning (ASTM D635)
 - b. Self-Ignition Temperature (ASTM D1929)
 - c. Density of Smoke (ASTM D2843)

- E. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.
- F. Samples for Initial Selection:
 - 1. Submit minimum 2-inch by 2-inch samples. Indicate full color, texture and pattern variation.
- G. Samples for Verification:
 - 1. Submit minimum 4-inch by 4-inch sample for each type, texture, pattern and color of solid plastic fabrication.
- H. Mockups:
 - 1. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects.
 - 2. Build mockup of [each type of] Plastic Fabrication.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.05 QUALITY ASSURANCE

- A. Manufacturers Qualifications
 - 1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least three (3) consecutive years and which can show evidence of those materials being satisfactorily used on at least three (3) projects of similar size, scope and location. At least one (1) of the projects shall have been successful for use one year or longer.
 - 2. Manufacturer must offer a documented reclaim process that will take back, at the manufacturers cost, panels that are at their end-of life cycle. Return process is preceded by following requirements highlighted in Section 02 41 00 - Demolition.
 - 3. Manufacturer must have documented training and qualification program for fabrication and installation of plastic fabrications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective packaging.
- B. Do not deliver Plastic Fabrications, system, components and accessories to Project site until areas are ready for installation.
- C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements. Materials are to be protected against damage from moisture and direct sunlight.
- D. Store 3form Chroma in area of installation minimum of 24 hours prior to installation.
- E. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.
- F. Before installing Plastic Fabrications, permit them to reach room temperature.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install Solid Polymer Fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.08 WARRANTY

- A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.
- B. Warranty Period: 1 year after ship date.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Manufacturer: 3form, Inc., Salt Lake City, Utah, USA / telephone 801-649-2500

2.02 MATERIALS

- A. 3form Chroma
 - 1. Engineered acrylic resin
 - 2. Sheet Size: Maximum 4' x 10'
 - 3. Thickness: As indicated on Drawings
 - 4. Basis of Design Product: The design of Plastic Fabrications is based on Chroma as provided by 3form, Inc.; or equal. Products from other manufacturers must be approved by the Architect or Designer prior to bidding in accordance with the Instructions to Bidders and Section 01 63 00 - Product Substitution Procedures.
- B. Sheet minimum performance attributes:
 - 1. Rate of Burning (ASTM D 635). Material must attain CC2 Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
 - 2. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-ignition temperature greater than 850°F.
 - 3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 10%.
 - 4. Color infusion must use water soluble dyes and penetrate at least 150 microns into material.
 - 5. Applied coatings must be low-VOC, contain non-toxic pigments, not contain any heavy metals and be approved for exterior use.
 - 6. Matte surface should be completely renewable onsite.

2.03 FABRICATION

- A. Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings, additional fabrication and installation details can be found on the 3form Partner Preliminary Project Review, if applicable.

- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
 - 1. Sawing: Select equipment and blades suitable for type of cut required.
 - 2. Drilling: Drills specifically designed for use with plastic products.
 - 3. Routing
 - 4. Tapping
- D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
 - 1. Cold Bending
 - 2. Hot Bending
 - 3. Thermoforming: Acceptable only on uncoated material.
 - 4. Drape Forming
 - 5. Matched Mold Forming
 - 6. Mechanical Forming
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.04 MISCELLANEOUS MATERIALS

- A. Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Fasteners: Use screws designed specifically for plastics. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.
- D. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for the installation of Plastic Fabrications. Sizes, profiles and other characteristics are indicated on the drawings, additional installation details can be found on the 3form Partner Preliminary Project Review, if applicable.
- B. Manufacturer's shop to fabricate items to the greatest degree possible.
- C. Installation should be performed by an authorized 3form Partner, if available.

- D. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
- E. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
- F. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.03 CLEANING AND PROTECTION

- A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

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 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010.
- B. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
- C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2012.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
 - 1. Use 2016 as indicated in CBC 2016 Referenced Standards.
- F. FDA Food Code - Chapter 6 - Physical Facilities; current edition with Supplements, if any.
- G. ISO 846 - Plastics - Evaluation of the Action of Microorganisms; 1997.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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 63 00 - Product Substitution Procedures, for additional provisions.

1.04 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. 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.; Panolam FRP: www.panolam.com
5. Parkland Performance; Plas-Tex PolyWall; www.parklandplastics.com.

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. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
 4. Impact Strength: Greater than 6 ft lb force per inch, when tested in accordance with ASTM D256.
 5. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
 6. 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 05 53
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Paint finish.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
- C. Schedule: Completely define scope of proposed marking. Indicate location of affected walls and partitions, and number of markings.
- D. Samples: Submit two samples of each type of marking proposed for use, of size similar to that required for project, illustrating font, wording, and method of application.

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 FIELD CONDITIONS

- A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Partition Identification Labels:
 - 1. Fire Wall Signs, Inc: www.firewallsigns.com.
 - 2. Safety Supply Warehouse, Inc: www.safetysupplywarehouse.com.
 - 3. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of the building code.
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl or paper sign with factory applied adhesive backing.
- C. Languages: Provide all markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Locate markings as required by CBC Section 703.7.
- B. Install adhered markings in accordance with manufacturer's instructions.
- C. Install neatly, with horizontal edges level.
- D. Protect from damage until Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at exterior wall behind plaster or rainscreen wall finish.
- B. Batt insulation and vapor retarder in exterior wall and ceiling construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- D. Batt insulation for acoustic applications in interior walls.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 40 00 - Cold-Formed Metal Framing: Board insulation as wall sheathing.
- C. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07 54 00 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.
- E. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- F. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2016a.
 - 1. Use 2012b as indicated in 2016 CBC Referenced Standards.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015b.
 - 1. Use 2012b as indicated in 2016 CBC Referenced Standards.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
 - 1. Use 2012a as indicated in 2016 CBC Referenced Standards.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
 - 1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016.
 - 1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
 - 1. Materials List: Submit materials list, stating manufacturer and product identification for each product specified, including R-Value and fire resistance and surface burning characteristics specified herein.
- C. 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.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 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. Maximum flame-spread and smoke developed indices are 25 and 450 respectively.
 - 2. Fire Resistance Ratings: ASTM E119.
 - 3. Combustibility: ASTM E136.
- B. Comply with Chapter 12-13 Standards for Insulating Materials, 1998 California Reference Standards Code (Part 12, Title 24. CCR) as published by Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation.
- C. 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.
- D. Performance: Materials shall conform to Section 719, California Building Code.

2.02 RECYCLE CONTENT

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
 - 1. Batt and Roll Insulation: 25-30 percent.
 - 2. Rigid and Semi-rigid Boards and Rolls: 25 percent.
 - 3. Roofing Systems Products: 30-40 percent.
 - 4. Safing Insulation: 70 - 90 percent.
 - a. Standard Fiber - Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 70 percent.

2.03 APPLICATIONS

- A. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) carbon black board.
- B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.
- C. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.
- D. Insulation Over Roof Deck: Polyisocyanurate board, as part of roofing assembly see roofing section.

2.04 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class B - 26 to 75, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
 - 5. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 - 6. Board Edges: Tongue-and-groove.
 - 7. Manufacturers:
 - a. Dow Chemical Company; STYROFOAM Ultra SL:
www.dowbuildingsolutions.com/#sle.
 - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation:
www.ocbuildingspec.com/#sle.
 - 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Complies with ASTM C578, and manufactured using carbon black technology.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
4. Board Size: 48 inch by 96 inch.
5. Board Thickness: 1-3/4 inch.
6. Board Edges: Shiplap, at long edges.
7. Manufacturers:
 - a. Dow Chemical Company; STYROFOAM Brand Ultra SL (Shiplap): www.dowbuildingsolutions.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.05 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, 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:
 - a. Thermal Resistance: R-value of 19.
 - b. Thickness: 5-1/2 inch.
 6. Facing: Aluminum foil, flame spread 25 rated; one side.
 7. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville: www.jm.com.
 - c. Knauf Insulation: www.knauf.com.
 - d. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Typical at interior walls.
 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 3. Thickness: 2 inch.
 4. Manufacturers:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.

- C. Flexible Blanket Insulation: Thin profile insulation that complies with complex shapes, unfaced; flame spread index of 5 (five) and smoke development index of 10 (ten) or less when tested in accordance with ASTM E84.

2.06 ACCESSORIES

- A. Insulation Fasteners: Lengths of unfinished, 13 gage, 0.072 inch high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.
- B. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
- C. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- D. 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 irregularities.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install boards horizontally on walls.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- 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.
- E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.

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 Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
- B. Air Barriers: Materials that form a system to stop passage of air through joints between exterior walls and roof and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS

- A. Section 07 21 00 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.
- B. Section 07 26 16 - Under-Slab Vapor Retarder: Vapor retarder under concrete slabs on grade.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- D. Section 07 62 70 - Exterior Penetration Flashing Panels: Prefabricated flashing sleeves and collars for electrical, mechanical and plumbing items protruding through exterior walls.
- E. Section 07 92 00 - Joint Sealants: Sealing building expansion joints.
- F. Section 09 24 00 - Cement Plastering: Water-resistive barrier provided in this section under exterior plaster.

1.03 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- C. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.04 REFERENCE STANDARDS

- A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2014.
- B. AATCC Test Method 16 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

1. Use 2016 as indicated in 2016 CBC Referenced Standards.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- G. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc; 2013.

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 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- E. Manufacturer's Installation Instructions: Indicate preparation.
- F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification; keep copies of each contractor accreditation and installer certification on site during and after installation, and present on-site documentation upon request.
- H. Testing Agency Qualification Statement.
- I. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in District's name and registered with installer.

1.07 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 2. 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.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.08 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

1.09 SPECIAL BUILDING ENCLOSURE WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions. www.edacontractors.com/#sle

1.10 WARRANTY

- A. Extended Warranty:
 - 1. Provide written guarantee from waterproofing membrane manufacturer, and furnish joint written warranty to District from waterproofing applicator and Contractor, covering all membranes, and other elements essential to be watertight and will continue to be watertight for a period of at least five years following Acceptance of the Work.
 - 2. Waterproofing membrane manufacturer, and waterproofing applicator and Contractor shall, upon request by District, make all repairs, at no cost to District and without dollar limit, as necessary to correct all waterproofing membrane material or workmanship defects.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.
 - 1. Under Portland cement stucco, additionally use two separate layers of building paper.
- B. Air Barrier:
 - 1. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type.

2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER OR VAPOR RETARDER)

- A. Building Paper: Asphalt-saturated Kraft building paper complying with requirements of ICC-ES AC38 Grade D.
 - 1. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of five hours, when tested in accordance with AATCC Test Method 127.
 - 2. Manufacturers:
 - a. Fortifiber Building Systems Group; Super Jumbo Tex 60 Minute: www.fortifiber.com/#sle.
 - b. Fortifiber Corporation JUMBO-TEX secondary layer only, asphalt-saturated Kraft-Type paper complying with Federal Specification UUB 790a, Type 1, Grade D, Style 2.

2.03 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier Sheet, Mechanically Fastened: Primer is not required on substrate materials.

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.
3. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of 5 hours, when tested in accordance with AATCC Test Method 127.
4. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 180 days of weather exposure.
5. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.
6. Water Resistance: Comply with applicable water-resistive requirements of ICC-ES AC38.
7. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2 inches wide, compatible with sheet material; unless otherwise specified.
8. Products:
 - a. Basis of Design Product: WeatherSmart Drainable (ESR 3791) as manufactured by Henry Company, or equal.
 - b. Certainteed, Inc.; CertaWrap Weather-Protection Membrane: www.certainteed.com.
 - c. DuPont Building Innovations; Tyvek Commercial Wrap D with Tyvek Fluid Applied Flashing and Joint Compound, FlexWrap NF, StraightFlash, StraightFlash VF, Tyvek Wrap Caps, and Tyvek Tape: www.dupont.com/#sle.
 - d. Fiberweb, Inc; Typar MetroWrap: www.typar.com/#sle.
 - e. Fortifiber Building Systems Group(Henry Company); WeatherSmart Drainable: www.fortifiber.com/#sle.

2.04 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 1. Composition: Any material that meets physical requirements of ASTM D1970/D1970M with exceptions indicated.
 2. Manufacturers:
 - a. Carlisle Coatings and Waterproofing, Inc.; CCW-705 TFW: www.carlisle-ccw.com.
 - b. CETCO ; Product Strong Seal SA; www.cetco.com.
 - c. DuPont de Nemours, Inc; StraightFlash: www.dupont.com/#sle.
 - d. DuPont de Nemours, Inc; StraightFlash VF: www.dupont.com/#sle.
 - e. Fortifiber Building Systems Group (Henry Company); FortiFlash Commercial: www.fortifiber.com/#sle.
 - f. InterWrap, Inc. Mission, BC Canada ; Product Titanium-PSU-30; www.interwrap.com.
 - g. Protecto Wrap; Jiffy Seal 140/60 Air/Vapor Barrier: www.protectowrap.com.

- h. Soprema, Inc.; Product Lastobond Shield HT MU; www.soprema.us.
 - i. W. R. Grace; Perm-A-Barrier Detail Flashing; www.na.graceconstruction.com.
 - j. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Pre-formed Transition Membrane: Semi-rigid silicone or polyester composition, tapered edges, and tear resistant.
- 1. Manufacturers:
 - a. Dow Chemical Company; DOWSIL Silicone Transition Strip and System: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - b. Fortifiber Building Systems Group (Henry Company); Moistop Corner Shield: www.fortifiber.com/#sle.
 - c. Momentive Performance Materials, Inc/GE Construction Sealants; 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.
- D. Vapor Retarder Tape: Coated polyester film with acrylic adhesive backing; pressure sensitive.
- 1. Manufacturers:
 - a. Fortifiber Building Systems Group (Henry Company); Fortifiber Sheathing Tape: www.fortifiber.com/#sle.
- E. Sheet Membrane Mounting Tape: Double-sided strip of pressure-sensitive, acrylic adhesive reinforced with embedded fiber-strand carrier layer and plastic backing.
- 1. Width: 3/4 inch.
 - 2. Roll Length: 164 feet.
 - 3. Thickness: 14 mil, 0.014 inch.
 - 4. Manufacturers:
 - a. SIGA Cover Inc; SIGA-Twinet Double-Sided Mounting Tape: www.sigacover.com/#sle.
- F. Liquid Flashing: One part, fast curing, non-sag, gun grade, trowelable liquid flashing.
- 1. Manufacturers:
 - a. Dow Chemical Company; DOWSIL 791 Silicone Weatherproofing Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - b. Momentive Performance Materials, Inc/GE Construction Sealants; Elemax 5000 Liquid-Applied Flashing: www.siliconeforbuilding.com/#sle.
 - c. Parex USA, Inc; Parex USA WeatherTECH with WeatherFlash: www.parexusa.com/#sle.
 - d. Polyglass USA, Inc; PolyFlash 1C One Part Flashing compound: www.polyglass.us/#sle.
- G. Mechanical, Electrical or other Penetrations: Provide flashing panels to weatherproof plumbing, HVAC, fire sprinkler and electrical penetrations in exterior walls combined with this section and Section 07 62 70 - Exterior Penetration Flashing Panels.
- H. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work 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 in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
 - 1. Apply water-resistive barrier complying with Section 1404.2 of the CBC, Section R703.2 of the CRC, or Section 1402.1 of the CBC.
- C. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
 - 1. Sheathing materials that serve as an air barrier shall comply with California Energy Code Table 140.3-A Section 140.3(a)9 Air Barriers A and B exceptions as listed.
- D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- E. Mechanically Fastened Sheets - On Exterior:
 - 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
 - 2. Overlap seams as recommended by manufacturer but at least 6 inches.
 - 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
 - 4. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
 - 5. For applications specified to be air tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
 - 6. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches below bottom of framing and seal to foundation with sealant.
 - 7. Install water-resistive barrier over jamb flashings.
 - 8. Install air barrier and vapor retarder underneath the jamb flashings.
 - 9. Install head flashings under weather barrier.
 - 10. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.

11. Penetration Sealing: Seal all penetrations through paper from backside using non-staining sealant as specified in Section 07 92 00 - Joint Sealants.
- F. Self-Adhered Sheets:
1. At sloped wall segments, all caps, parapets and horizontal projections, surfaces, all locations where products are secured through cement plaster and other locations where waterproof underlayment is indicated; install minimum one layer of self-adhesive sheet. Provide in addition to and integrated with weather barriers as indicated in this section.
 2. Penetration Flashing: Install self-adhering waterproof backing in weatherboard fashion following Plaster Institute recommendations.
 3. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
 4. Lap sheets shingle-fashion to shed water and seal laps air tight.
 5. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
 6. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
 7. At wide joints, provide extra flexible membrane allowing joint movement.
- G. Openings and Penetrations in Exterior Weather Barriers: Comply with Drawing details. As a minimum provide the following:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 2. At openings to be 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 to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather 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 weather barrier surface.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, for additional requirements.
- B. Water-Spray Test: Provide water spray quality test of installed weather barrier components in accordance with a modified AATCC Test Method 16 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, 50 percent, and 70 percent completion of this work.

3. Testing: Water test the complete weather barrier after completion by spraying with hose heavily for 5 minutes. Repair all leaks discovered by testing procedures and repeat test until leak-free performance is achieved.
 4. Provide written report to Architect and IOR.
- 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 weather barriers until required inspections have been completed.
- E. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- F. Take digital photographs of each portion of the installation prior to covering up.

3.05 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION

SECTION 07 26 16
UNDER-SLAB VAPOR RETARDER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor retarder under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 20 00 - Concrete Reinforcing: Coordination of placement of reinforcement with vapor retarder/barrier.
- C. Section 03 30 00 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.
- D. Section 31 20 00 - Earthwork: Preparation of building pad and base placed beneath vapor barrier.

1.03 REFERENCE STANDARDS

- A. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- B. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method; 2016a.
- C. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturers product data identifying specific product to be utilized.
- C. Shop Drawings: Indicate the following:
 - 1. Seaming Layout
 - 2. Penetration and termination details.
- D. Samples: Submit six material samples, 6 x 6 inch in size, illustrating actual materials to be installed.
- E. Specimen Warranty.
- F. Certificate: Certify that products of this section meet or exceed specified requirements.
- G. Test Reports: Indicate compliance with requirements listed in this section.
 - 1. Independent laboratory test results showing compliance with ASTM and ACI Standards.
- H. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.
- I. Manufacturer's Field Reports: Indicate Manufacturers review of field conditions at 50% installation and after installation of reinforcing, prior to placement of concrete..

- J. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Preinstallation Meeting: Convene a preinstallation meeting 2 weeks before start of installation of reinforced vapor retarders. Require attendance of parties directly affecting work of this section, including Manufacturer's Representative, Contractor, Architect, and installer. Review installation, protection, and coordination with other work.
- B. Coordination: Coordinate installation timing and sequence to maintain required moisture content in prepared subgrade.
- C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers and Products:
 - 1. Fortifiber Building Products Systems; Moistop Ultra 15, 15 mils thick (0.010 max. permeance), Class A, unreinforced polyolefin: www.fortifiber.com.
 - 2. Raven Industries; VaporBlock VB15, 15 mils thick (0.01 perms), Class A, unreinforced polyolefin: ravenfd.com,
 - 3. Reef Industries, Inc.; Vaporguard, 15 mil (E-96 0.000 perms), Class B: www.reefindustries.com
 - 4. Stego Industries LLC; Stego Wrap Vapor Barrier, 15 mils: www.stegoindustries.com.
 - 5. W.R. Meadows; Perminator, 15 mils thick (0.0063 perms, puncture resistant) Class A: www.wrmeadows.com.

2.02 PERFORMANCE REQUIREMENTS

- A. Water Vapor Permeance: Not more than 0.010 perms, maximum.
 - 1. Permeance as tested after conditioning (ASTM E1745).
- B. Comply with ASTM E1745 Class A.
- C. Puncture Resistance, ASTM D1709: 2,300 gms.

2.03 MATERIALS

- A. Reinforced Vapor Barrier:
 - 1. Minimum Thickness ACI 302.1R: 15 mil.
 - 2. Material: Multi-ply laminate/extrusion of Polyolefin.
- B. Sheet polyethylene membrane not acceptable.

2.04 ACCESSORIES

- A. General: Ensure accessories are from same manufacturer as reinforced vapor retarders.

1. Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.
- B. Adhesive Mastic: Adhesive compatible with sheet retarder/barrier and substrate materials, water vapor transmission rate of 0.3 perms or lower per ASTM E96/E96M. Membrane manufacturer's recommended elastomeric sealant.
- C. Adhesive Tape for Sheet Joint Sealing and Repair and Sealing of Miscellaneous Penetrations: Membrane manufacturer's recommended double sided tape with water vapor transmission rate of 0.03 perms or lower per ASTM E96/E96M.
 1. Mastic Tape: Manufacturer's system tape.
 2. Self-Adhesive Repair Tape: Manufacturer's system tape.
- D. Pipe and Conduit Boot:
 1. Manufacturers factory fabricated pipe boots.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive reinforced vapor retarders. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.
- B. Subbase: Per ACI 302.1R.
 1. Minimum 4 inch thick (or larger) base of 1/2 inch or larger clean aggregate, per CA Green Code 4.505.2.1.
 2. As indicated on Drawings and approved by the Geotechnical Engineer.
- C. Preparation: Ensure that crushed rock or sand base is tamped or rolled and level.
- D. Ensure subgrade beneath vapor retarder is smooth, level, and compacted with no sharp projections.
- E. Beginning installation shall indicate acceptance of conditions.

3.02 UNDERSLAB VAPOR RETARDER / BARRIER INSTALLATION

- A. Location: Provide vapor retarder/barrier under building slabs on grade to limits indicated on Drawings.
- B. Installation: Place sheet over crushed rock, as detailed on Drawings, without damaging sheeting.
 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
 - a. Install vapor retarders in largest practical widths.
 2. Place sheets continuous between footings or foundation walls, without voids.
 3. Lap vapor barrier over footings and/or seal to foundation walls.
 4. Lap all joints 6 inches minimum. Seal seams as noted below.
 5. Turn down sheeting 12 inches minimum along inside face of perimeter grade beams and/or continuous perimeter footings.

6. Fit sheeting tightly around column, pipe and conduit penetrations. Install standard pipe boot where possible, following manufacturer's instructions.
 - a. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
- C. Seam and Lap Sealing: With adhesive mastic and adhesive sealing tape, seal all seams, edges and penetrations of vapor retarder/barrier.
 1. For adhesive mastic seal, apply adhesive to both surfaces, allow approximately 10 minutes to set up and then press together smoothly and evenly, without gaps or fishmouths, for full contact bond.
 2. For adhesive tape seal, comply with manufacturer's instructions and recommendations.
 3. Seal all penetrations with both adhesive sealing tape and adhesive mastic.
 4. Seal sheets to concrete footing faces and penetrating components with adhesive mastic or double sided tape as recommended by membrane manufacturer.
- D. Ensure there is no moisture entrapment by vapor retarder due to rainfall or ground water intrusion.
- E. Immediately repair holes in vapor retarder with self-adhesive repair tape.
- F. Remedial Work: Inspect sheeting installation prior to placing fill materials. Repair all apparent and suspected damaged areas.
 1. Clean surface of sheeting.
 2. Cut patch from new sheeting material, overlapping damaged area 6 inches minimum, and apply over damaged area sealing in place with adhesive and tape.

3.03 PROTECTION

- A. Protect reinforced vapor retarders from damage during installation of reinforcing steel and utilities and during placement of concrete slab or granular materials.
- B. Immediately repair damaged vapor retarder in accordance with manufacturer's instructions

END OF SECTION

SECTION 07 42 13
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured plank and profiled metal panels for walls and soffits, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Wall panel substrate.
- B. Section 05 50 00 - Metal Fabrications: Wall panel substrate.
- C. Section 07 21 00 - Thermal Insulation.
- D. Section 07 25 00 - Weather Barriers: Weather barrier under wall panels.
- E. Section 07 42 13.23 - Metal Composite Material Wall Panels: Metal wall panels with or without composite filler.
- F. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.
- G. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.
- H. Section 09 21 16 - Gypsum Board Assemblies: Wall panel substrate.

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; 2015.
- B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage.
 - 1. Profile.
 - 2. Gauge of panel.
 - 3. Location, layout and dimensions of panels.
 - 4. Location and type of fasteners.
 - 5. Shape and method of attachment of all trim.
 - 6. Locations and type of sealants.
 - 7. Installation sequence.
 - 8. Other details as may be required for a weathertight installation.

- C. Samples: Submit two samples of wall panel and soffit panel, 12 inch by 12 inch in size illustrating finish color, sheen, and texture.
- D. Installer's Qualification Statement.
- E. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in District's name and registered with installer.
- F. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with requirements.
- G. Manufacturer Erection Instructions: Provide manufacturer's written installation instructions including proper material storage, material handling, installation sequence, panel location(s), and attachment methods, details and required trim and accessories.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation meeting: Conduct a pre-installation meeting at the job site attended by Owner, Architect, Manufacturer's Technical Representative, Panel Installer, and Contractors of related trades. Coordinate structural support requirements in relation to wall panel system, installation of any separate air/water barriers, treatment of fenestration, and other requirements specific to the project.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum three years of documented experience.
 - 1. Installer shall be authorized by the manufacturer and the work shall be supervised by a person having successfully completed a manufacturer training seminar regarding proper installation of the specified product

1.07 MOCK-UP

- A. Construct mock-up, 8 feet high by 12 feet wide; include panel system, , attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.
- B. Locate where directed by Architect.
- C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panel materials and components in manufacturer's original, unopened, undamaged packaging with identification labels intact.
- B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- C. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

1. Store wall panel materials on dry, level, firm, and clean surface. Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.
- D. Prevent contact with materials that may cause discoloration or staining of products.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
1. Paint Finish: Twenty (20) years from date Substantial Completion.
- C. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals.
- D. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions. www.edacontractors.com/#sle

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Wall Panels - Exposed Fasteners: Mechanical equipment screen.
1. Basis of Design Roof Screen Product: DEEP VERCOR as manufactured by Verco Decking, Inc., www.vercodeck.com, or approved equal.
- B. Metal Soffit Panels:
1. Basis of Design Product: Profile Series as manufactured by AEP Span, or approved equal.
 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated metal panel system, site assembled.
1. Provide exterior panels and soffit panels.
 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
 3. Design Pressure: In accordance with applicable codes.
 4. Maximum Allowable Deflection of Panel: $L/180$ for length(L) of span.
 5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 8. Corners: Factory-fabricated in one continuous piece with minimum 2 inch returns.
 9. Provide continuity of air barrier and vapor retarder seal at building enclosure elements in accordance with materials specified in Section 07 25 00.
- B. Exterior Wall Panels:
1. Profile: Vertical; style as indicated.
 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
 3. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.
 4. Panel Width: 12 inches.
 5. Color: PPG Duranar Sunstorm Coil coating with Mica Coatings, .
 - a. Color # : 5MW52579
 - b. Color name : Bone White
- C. Soffit Panels:
1. Profile: Single Span, 1 pencil rib and no vents.
 2. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.
 3. Color: As selected by Architect from manufacturer's full line.
- D. Expansion Joints: Same material, thickness and finish as exterior sheets; 20 gage, 20 inch thick; manufacturer's standard brake formed type, of profile to suit system.
- E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- F. Anchors: Galvanized steel.

2.03 MATERIALS

- A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS)) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Insulation: Glass fiber type specified in Section 07 21 00.

2.04 FINISHES

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.

2.05 ACCESSORIES

- A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- B. Concealed Sealants: Non-curing butyl sealant or tape sealant.
- C. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 1. Color: To be selected by Architect.

- D. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
 - 1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.
- E. Field Touch-up Paint: As recommended by panel manufacturer.
- F. Bituminous Paint: Asphalt base.

2.06 FABRICATION

- A. Metal wall panels and liner panels shall be formed to lap and interconnect with edges of adjacent panels which are then mechanically attached through panel to supports using concealed fasteners.
- B. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- C. Form pieces in longest practicable lengths.
- D. Fabricate metal wall panels to eliminate condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- E. Panels shall be factory formed. Field formed panels are not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that weather barrier has been installed over substrate completely and correctly.
- C. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.02 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.03 INSTALLATION

- A. Install panels on walls and soffits in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Cutting and fitting of panels shall be neat, square and true. Torch cutting is prohibited.
- D. Fasten panels to structural supports; aligned, level, and plumb.
- E. Locate joints over supports.
- F. Trim Installation: Apply sealant tape at trim, per manufacturer's details and approved shop drawings, for weathertight installation.
- G. Provide expansion joints where indicated or required.
- H. Use concealed fasteners unless otherwise approved by Architect.
- I. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.
- J. Sealant Installation for Exposed Joints:

1. Clean and prime surfaces to review exterior exposed sealants in accordance with sealant manufacturer's recommendations.
2. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

3.04 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.05 CLEANING

- A. Remove protective film immediately after installation.
- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Remove site cuttings from finish surfaces.
- D. Touch-up, repair or replace metal panels and trim that have been damaged.
- E. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 42 13.23
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.
- B. Matching flashing and trim.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Installation of anchors.
- B. Section 07 25 00 - Weather Barriers: Weather barrier behind wall panel system.
- C. Section 07 42 13 - Metal Wall Panels: Profiled wall panels to coordinate with this section.
 - 1. Preformed wall panels to match and coordinate with wall panel requirement for single source manufacturer
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.
- E. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016a.
- E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2016a.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- H. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- J. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

- L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- M. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- N. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).
- O. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.
- P. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2016.
- Q. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet; 2010.
- R. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
 - 1. Use 2013a as indicated in 2016 CBC Ch. 35 Referenced Standards.
- T. 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).
- U. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- V. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- W. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
 - 1. Require attendance by the installer and relevant sub-contractors.
 - 2. Include MCM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
 - 3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
 - 4. Review procedures for protection of work and other construction.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
 - 1. Finish manufacturer's data sheet showing physical and performance characteristics.

2. Storage and handling requirements and recommendations.
 3. Fabrication instructions and recommendations.
 4. Specimen warranty for finish, as specified herein.
- C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
1. Physical characteristics of components shown on shop drawings.
 2. Storage and handling requirements and recommendations.
 3. Installation instructions and recommendations.
 4. Specimen warranty for wall system, as specified herein.
- D. Shop Drawings: Show actual panel layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
1. Indicate panel numbering system.
 2. Differentiate between shop and field fabrication.
 3. Indicate substrates and adjacent work with which the wall system must be coordinated.
 4. Include large-scale details of anchorages and connecting elements.
 5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
- E. Selection Samples: For each finish product specified, submit at least three sample color chips representing manufacturer's standard range of available colors and patterns.
1. Sealant Color: Color as selected by Architect.
- F. Verification Samples: For each finish product specified, submit at least three samples, minimum size 12 inch square, and representing actual product in color and texture.
- G. Certificate: Certify that the work results of this section meet or exceed specified requirements.
- H. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
- I. Test Report: Submit report of full-size mock-up test for NFPA 285 fire performance.
- J. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
- K. Installer's Qualification Statement.
- L. Maintenance Data: Care of finishes and warranty requirements.
- M. Executed Warranty: Submit warranty and ensure that forms have been completed in District's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
- B. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.

1. With not less than three years of documented experience.
 2. Approved by MCM sheet manufacturer.
 3. Submit contact names and phone numbers for at least three references connected with successful past projects.
 4. Manufacturer shall be single-source in combination with Sections 07 42 13.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section.
1. With minimum three years of documented experience.
 2. Approved by wall panel system manufacturer.
 3. Submit contact names and phone numbers for at least three references connected with successful past projects.
- D. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.
- E. Maintain at least one copy of the approved shop drawings on site during installation.
- F. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
1. Locate where directed.
 2. Provide panels finished as specified.
 3. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
1. Protect finishes by applying heavy duty removable plastic film during production.
 2. Package for protection against transportation damage.
 3. Provide markings to identify components consistently with drawings.
 4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
1. Store in well ventilated space out of direct sunlight.
 2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
 3. Store at a slope to ensure positive drainage of any accumulated water.
 4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
 5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Wall System Warranty: Provide joint written warranty by manufacturer and installer, agreeing to correct defects in manufacturing or installation within a two year period after Date of Substantial Completion.
- C. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 5 years:
 - 1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
 - 2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
 - 3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: 3A Composites USA; Alucobond: www.alucobondusa.com.
- B. Basis of Design: Alcoa Architectural Products, Inc; Reynobond Aluminum Composite Material (ACM): www.alcoaarchitecturalproducts.com.
- C. Metal Composite Material (MCM) Sheet Manufacturers:
 - 1. 3A Composites USA; Alucobond: www.alucobondusa.com/#sle.
 - a. ICC ESR-1114
 - b. ICC ESR-1185
 - 2. ACPEXpress: www.acpexpress.com.
 - 3. Alcoa Architectural Products, Inc; Reynobond Aluminum Composite Material (ACM): www.alcoaarchitecturalproducts.com.
 - a. ICC ESR-3435
 - b. ICC ESL-1076
 - 4. ALPOLIC Materials; ALPOLIC/fr (Fire Retardant core): www.alpolic-america.com/#sle.
 - a. ICC ESL-1018
 - 5. Citadel Architectural Products, Inc; Envelope 2000: www.citadelap.com/#sle.
 - a. ICC ESR-1015
 - 6. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Wall Panel System Manufacturers:
 - 1. Basis of Design Product: Reynobond Aluminum Composite Material (ACM) as manufactured by Alcoa Architectural Products, Inc., or approved equal.
 - 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 WALL PANEL SYSTEM

- A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
 - 1. Provide panel jointing and weatherseal using reveal joints and gaskets but no sealant.
 - 2. Anchor panels to supporting framing without exposed fasteners.
- B. Performance Requirements:
 - 1. Provide tests on full-size mock-ups; tests performed previously for other projects are acceptable provided tested assemblies are truly equivalent to those to be used on this project, unless otherwise indicated.
 - 2. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
 - 3. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
 - a. Design Wind Pressure: As specified in Structural Drawings.
 - b. Maximum deflection of perimeter framing member of $L/175$ normal to plane of the wall; maximum deflection of individual panels of $L/60$.
 - c. Maximum anchor deflection in any direction of $1/16$ inch at connection points of framing members to anchors.
 - 4. Air Infiltration: 0.06 cfm/sq ft of wall area, maximum, when tested at 1.57 psf in accordance with ASTM E283.
 - 5. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
 - a. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
 - b. Design to drain leakage and condensation to the exterior face of the wall.
 - 6. Fire Performance: Tested in accordance with, and complying with the acceptance criteria of, NFPA 285; testing performed for previous project is acceptable provided tested system was truly equivalent.
- C. Panels: 2 inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
 - 1. Reinforce corners with riveted aluminum angles.
 - 2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
 - 3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.

4. Reinforce panels over 36 inches long with metal angle braces 24 inches on center in short direction.
5. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
6. Metallic Finished Panels: Maintain consistent grain of MCM sheet; specifically, do not rotate sheet purely to avoid waste.
7. Fabricate panels under controlled shop conditions.
8. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
9. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
 - a. Make panel lines, breaks, curves and angles sharp and true.
 - b. Keep plane surfaces free from warp or buckle.
 - c. Keep panel surfaces free of scratches or marks caused during fabrication.
10. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.
11. For "dry" jointing, secure extrusions to returned pan edges with stainless steel rivets; provide means of concealed drainage with baffles and weeps for water that might accumulate in members of system.

2.03 MATERIALS

- A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
 1. Overall Sheet Thickness: 4 mm, minimum.
 2. Face Sheet Thickness: 0.020 inches, minimum.
 3. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
 4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
 5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 6. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
 7. Factory Finish: Two coat fluoropolymer resin coating, approved by the coating manufacturer for the length of warranty specified for the project, and applied by coil manufacturing facility that specializes in coil applied finishes.
 - a. Coating Flexibility: Pass ASTM D4145 minimum 1T-bend, at time of manufacturing.
 - b. Long-Term Performance: Not less than that specified under WARRANTY in PART 1.
 8. Color: As selected by Architect from manufacturer's custom range including two coat mica and three-coat metallics.

- B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
 - 1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
 - 2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
 - 3. Stainless Steel Sheet Components: ASTM A480/A480M.
 - 4. Aluminum Components: ASTM B209 (ASTM B209M); or ASTM B221 (ASTM B221M).
- C. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet; refer to Section 07 62 00 for additional requirements.
- D. Flashing Tape: 4 inch (102 mm) wide self-adhering butyl flashing tape.
- E. Gaskets: Panel manufacturer's EPDM or neoprene, fire-retardant-treated.
- F. Anchors, Clips and Accessories: Use one of the following:
 - 1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
 - 2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
 - 3. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 10.
- G. Fasteners:
 - 1. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
 - 2. Bolts: Stainless steel.
 - 3. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.
- H. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15 mil dry film thickness per coat.
- I. Joint Sealer: As specified in Section 07 92 00, subject to MCM sheet manufacturer's approval.
- J. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.
- K. Vertical Application Weather Barrier: See Section 07 25 00 - Weather Barriers.
- L. Horizontal Application Underlayment: Flexible flashing per Section 07 25 00 - Weather Barriers.

2.04 FABRICATION

- A. General: Fabricate composite wall panels and accessories at factory identical to tested units using manufacturer's standard procedures and processes necessary to meet performance requirements.

1. Provide components of composite wall panel system that are products of one manufacturer, including composite panels, gaskets, head and sill trim, bottom weep, base extrusion, and metal copings.
- B. Composite Panels: Fabricate composite wall panels with extruded aluminum stiffeners requiring no further fabrication or modification in field.
 1. Horizontal Joints: Dry seal, drained and back ventilated.
 2. Vertical Joints: Pre-formed returns with metal spline and aluminum extrusion receptors and extruded drain channels.
 3. Reveals: 0.50 inch.
 4. Formed Panel Thickness: 2 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine dimensions, tolerances, and interfaces with other work.
- B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.
 1. Examine composite wall panel system substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of composite wall panel system.
 2. Inspect framing that will support composite wall panel system to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to composite wall panel system manufacturer.
 - a. Maximum deviations acceptable to composite wall panel system manufacturer:
 - 1) 1/4 inch in 20 feet vertically or horizontally from face plane of framing.
 - 2) 1/2 inch maximum deviation from flat substrate on any building elevation.
 - 3) 1/8 inch in 5 feet.
 3. Confirm presence of acceptable framing members to match installation requirements of composite wall panel system.
 - a. Confirm framing minimum 16 ga., 0.053 inch at maximum 24 inch spacing.
 4. Verify that window, door, louver and other penetrations match layout on shop drawings.
 5. Correct out-of-tolerance work and other deficient conditions prior to proceeding with composite wall panel system installation.
- C. Correct out-of-tolerance work and other deficient conditions prior to proceeding with composite wall panel system installation.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect adjacent work areas and finish surfaces from damage during installation.

- B. Provide anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.
 - 1. Refer to Section 03 30 00 for additional cast in place concrete requirements.
 - 2. Refer to Section 04 20 00 for additional unit masonry requirements.

3.03 INSTALLATION

- A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
- B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
- C. Accessories: Install all components required for a complete assembly, including flashings, gutters, trim, moldings, closure strips, preformed crickets, closures, and similar accessory items.
- D. Install underlayment on horizontal surface before installing metal panels. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 2 inches and side and end laps a minimum of 3 inches. Offset underlayment seams.
- E. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
- F. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- G. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
- H. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
- I. Where joints are designed for field applied sealant, seal joints completely with specified sealant.
- J. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
- K. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
 - 1. Variation From Plane or Location: 1/4 inch in 15 feet of length and up to 3/4 inch in 300 feet, maximum.
 - 2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
 - 3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
 - 4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.
- L. Replace damaged products.
 - 1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by Architect, panel manufacturer, and fabricator.

2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet under all typical light conditions experienced at the project.

3.04 FIELD QUALITY CONTROL

- A. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.
 1. Site Visits: Schedule two site visits during execution of installation.

3.05 CLEANING

- A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

- A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 54 00
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered system with thermoplastic roofing membrane.
 - 1. Membrane is OFCI, to be provided by a CMAS contract. Other components are by installing contractor. See Attachment A following this section.
- B. Insulation, tapered.
- C. Cover Board
- D. Flashings.
 - 1. Clad Metal Flashing
- E. Roofing cant strips, stack boots, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings, reglets.
- B. Section 07 72 00 - Roof Accessories: Roof-mounted units; prefabricated curbs.
- C. Division 22 - Plumbing: Roof drains, plumbing penetrating roofing membrane.
- D. Division 26 - Electrical.
 - 1. Conduit penetrating roofing membrane.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
 - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2016.
 - 1. Use 2013e1 as indicated in 2016 CBC Referenced Standards.
- D. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2015.
 - 1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- E. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011.
- F. FM (AG) - FM Approval Guide; current edition.
- G. FM DS 1-28 - Wind Design; 2007.
- H. NRCA (RM) - The NRCA Roofing Manual; 2017.
- I. NRCA (WM) - The NRCA Waterproofing Manual; 2005.
- J. UL (FRD) - Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. 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 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. Construction Manager, Architect's insurer, independent testing and inspection agency and 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, Architect and independent testing and inspection agency shall not relieve Contractor of sole responsibility for means, methods, techniques and sequence of construction, in accordance with provisions of the Conditions of the Contract.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data indicating physical properties of membrane materials, flashing materials, adhesives, and cover board.
- C. Applicator's(Contractor) Specimen Warranty: For approval.
- D. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's Installation Instructions: Indicate membrane seaming precautions 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.
- G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- H. Installer's Qualification Statement.
- I. Specimen Warranty: For approval.
 - 1. Applicator's(Contractor) Specimen Warranty: For approval.
- J. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.
- K. Installer's qualification data.
 - 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.
- L. Applicator Warranty: Submit applicators/ contractor's warranty and ensure forms have been completed in District's name and registered with manufacturer.
- M. Material Safety Data Sheet: For all products submitted. For Contractor's use only.

1.06 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. Roofing System shall be Energy Star Certified.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty-five years of documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with at least five years of documented experience and approved by manufacturer.

- E. 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).
 - 3. Perform work in accordance with NRCA (RM) and NRCA (WM).
 - a. Maintain one copy on site.
- F. 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 45 00 - Quality Control.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture.
 - 1. Place all materials on pallets and fully protect from moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.
- 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.

1.08 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather. Consult with the Manufacturer, as installation time and system integrity may be affected.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 95 degrees F.
 - 1. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
 - 1. All seams shall be cleaned and heat welded before leaving the job site that day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

- F. Temporary Roofing: Provide temporary roof membrane if necessary to protect portions of the Work before final roofing can be installed.
 - 1. Record by way of change order the District's agreement to proceed with temporary roofing, along with additional costs and other changes (if any) to Contract Documents.
 - 2. Remove temporary roofing before starting installation of final roofing system.
- G. 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.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind within the limits specified.
 - 1. Warranty shall also include insulation and flashing as part of the roofing system and all other manufacturer supplied system components to be used as part of the roofing assembly..
 - 2. Warranty Term: 20 years, Non-Prorated and no dollar limit (NDL).
 - 3. Provide a written guarantee signed by the manufacturer's authorized official, agreeing to correct failures in product and installation, with no dollar limit on such corrections, for the noted warranty term from date established in Notice of Completion.
 - 4. For repair and replacement include costs of both material and labor in warranty.
 - 5. Exceptions Not Permitted:
 - a. Damage due to roof traffic or storage.
 - b. Damage due to wind speed greater than 56 mph but less than 90 mph.
 - c. Damage due to "bird baths," or ponding water during the warranty period.
- C. Applicator/Roofing Contractor Warranty:
 - 1. The Applicator shall supply the District with a separate five-year workmanship warranty.
 - 2. 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.
 - 3. The Applicator's warranty obligation shall run directly to the District, and a copy shall be sent to the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. CMAS Contract Campus Standard Basis of Design Product: TPA FB as manufactured by Tremco.
 - 1. Tremco Contact: Steve Tolsma, 714.443.1744, stolsma@tremcoinc.com
- B. Insulation:
 - 1. Any insulation as part of the tested and warrantable roofing system membrane assembly.

2.02 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.
 - 1. Safety Factor: As required by code; minimum 2.0
 - 2. Factory Mutual Research Corporation (FM) - Norwood, MA: Class 1-90 (Attachment Criteria)

2.03 ROOFING

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over vapor retarder and insulation.
 - 1. Roof Assembly: (from the top down)
 - a. Roofing Membrane, Class A.
 - b. Cover Board - Glass mat gypsum panel.
 - c. Insulation - Minimum R-30 Rigid board.
 - 1) Additional tapered layers for crickets.
 - d. Roof deck.
- B. Roofing Assembly Requirements:
 - 1. Solar Reflectance Index (SRI): 108, minimum, calculated in accordance with ASTM E1980.
 - a. Field applied coating may not be used to achieve specified SRI.
 - 2. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.
 - 3. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28. FM Certification is not required.

2.04 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials: (OFCl)
 - 1. PVC: Polyvinyl chloride (PVC) conforming to ASTM D4434/D4434M, Type IV, sheet contains reinforcing fibers or reinforcing fabrics.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
 - b. Backing: Non-woven polyester fleece.
 - 2. Sheet Width: Factory fabricated into largest sheets possible.
 - 3. Solar Reflectance: 0.86, minimum, initial, and 0.65, minimum, 3-year, certified by Cool Roof Rating Council.
 - 4. Thermal Emissivity: 0.86, minimum, initial, and 0.79, minimum, 3-year, certified by Cool Roof Rating Council.
 - 5. Color: White, integral.
- B. Seaming(Welding) Materials: As recommended by membrane manufacturer.
- C. Insulation and Cover Board Fasteners and Plates: As recommended and approved by membrane manufacturer.
- D. Flexible Flashing Material: Material recommended by membrane manufacturer.

2.05 COVER BOARD

- A. Cover Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/4 inch thick.
 - 1. Application: Over insulation and at parapet wall studs.
 - 2. Manufacturers:
 - a. Georgia-Pacific; DensDeck Prime: www.densdeck.com/#sle.
 - b. National Gypsum Company; DEXcell Glass Mat Roof Board: www.nationalgypsum.com/#sle.
 - c. USG Corporation; Securock Ultralight Glass-Mat Roof Board: www.usg.com/#sle.

2.06 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II:
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of 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 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F.
 - 2. Board Size: 48 by 96 inch.
 - 3. Board Thickness: 3.0 inch, maximum, single layer.
 - 4. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.

5. Board Edges: Square.
6. Manufacturers:
 - a. Dow Chemical Co; THERMAX: www.dow.com.
 - b. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
 - c. Rmax Inc.; ECOMAXci: www.rmax.com.
 - d. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.

2.07 ACCESSORIES

- A. Clad Metal Flashing:
 1. Description: PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles.
 2. Materials: 24 gauge, G90 galvanized metal sheet with a 20 mil (0.5 mm) unsupported roofing membrane laminated on one side.
 3. Clad Metal Color: Match roofing membrane.
- B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- C. Butyl Tape: Two-sided rubber type, width as required, self adhering.
 1. Basis of Design Product: TremFlash (TF) Tape as manufactured by Tremco, or approved equal.
- D. 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.
- E. Membrane Adhesive: As recommended by membrane manufacturer.
- F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- G. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- H. Insulation Adhesive: As recommended by insulation manufacturer.
- I. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.
- J. Termination Bar: 1.34 inch wide extruded aluminum, pre-punched strip.
- K. Sealants: As recommended by membrane manufacturer.
- L. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane. Used as a protection layer from rooftop traffic.
 1. Composition: Roofing membrane manufacturer's standard.
 2. Size: Manufacturer's standard size(s).
 3. Surface Color: Light Gray.

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. The roof deck and existing roof construction must be structurally sound to provide support for the new roof system.
 - a. Applicator shall load materials on the rooftop in such a manner to eliminate risk of deck overload due to concentrated weight.
 - b. Contractor shall ensure that the roof deck is secured to the structural framing according to local building code and in such a manner as to resist all anticipated wind loads in that location.
- 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.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and nailing strips and reglets are in place.

3.02 CONCRETE DECK PREPARATION

- A. Fill surface honeycomb and variations with latex filler.
- B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.03 INSTALLATION - GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.04 INSULATION AND COVER BOARD INSTALLATION - UNDER MEMBRANE

- A. Loosely apply vapor retarder directly over the deck surface with adhesive and all side and end joints sealed in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under cant strips and blocking to deck edge.
 - 2. Seal all penetrations and terminations.

3. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
 - C. Attachment of Insulation:
 1. Embed first layer of insulation in full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
 2. Mechanically fasten subsequent layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
 - D. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
 - E. Lay subsequent layers of insulation and cover board with joints staggered minimum 6 inch from joints of preceding layer.
 - F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
 - G. Lay boards with edges in moderate contact without forcing. Cut to fit neatly to perimeter blocking and around penetrations through roof.
 - H. At roof drains, use boards cut to slope to slope down to roof drains over a distance of 18 inches.
 - I. Do not apply more insulation or cover board than can be covered with membrane in same day.

3.05 MEMBRANE APPLICATION

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate of no less than 0.69 gal/square. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. Mechanical Attachment: Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.
 1. Install mechanical fasteners at terminations, penetrations, and perimeter of roofing.
- F. At intersections with vertical surfaces:
 1. Extend membrane up base angles a minimum of 8 inches onto vertical surfaces.
 2. Fully adhere flexible flashing over membrane and up to nailing strips.
 3. Secure flashing to nailing strips at 4 inches on center.
 4. Insert flashing into reglets and secure.
- G. Around roof penetrations, seal flanges and flashings with flexible flashing.
- H. Coordinate installation of roof drains and sumps and related flashings.

- I. Over the completed roof membrane system, install a perimeter bar at 4 feet, and 8 feet. spacing from the base angle of the parapet wall or building's edge and cover with a membrane cove strip welded to the field sheet on both sides of the perimeter bar.
 - 1. This securement is an assembly and application requirement.
- J. 4 inch wide, 24 gauge metal strap shall be applied to the parapet wall studs to receive the intermediate fastening required for wall flashing membrane securement to the parapet wall.
 - 1. Straps shall be applied 30 inches from the base angle of the wall and repeated at this same spacing interval.

3.06 FINISHING UNBALLASTED SURFACES

- A. Install walkway pads. Space pad joints to permit drainage.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing material manufacturers daily during installation of the Work.
 - 1. Roofing system manufacturer shall provide to Architect a written on site approval and sign off on pre-roofing deck, insulation installation, membrane installation, flashing details and completed assembly.
 - 2. 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.
- C. Regular daily written reports shall be provided to the Contractor and Architect for every day of roofing installation work.
- 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 Chapter V, "Quality Control," of The NRCA Low-Slope Roofing Manual.
 - 2. Independent agency will provide reports of inspections and tests to Construction Manager 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.

3.08 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

Attachment A

**Owner Purchased Material List for Roofing Project at the Following Site:
Compton Community College – Student Services Building**

The following material list is to be included in the bid form and signed/dated by the Contractor. Failure to provide this information will render your bid unresponsive. The owner is purchasing the following list of materials from the CMAS contract #4-18-00-118A, quote #5038878. Only these materials, in the quantities listed, will be supplied.

The Contractor is responsible for purchasing any additional material directly from the roofing material manufacturer and/or other supplier at the Contractor’s cost. The contractor is also responsible for ALL other items not on this list necessary for the completion of work specified. This includes, but is not limited to, fasteners, adhesives insulation, tapered insulation, cants and taper edge, metal components, warranty charges, inspections, and other consumable materials.

The unloading of material and the storage of said material in a secure area is the sole responsibility of the Contractor. Any unused material will become the property of the Owner at the completion of the project.

<u>Material</u>	<u>Quantity</u>	<u>Roll Size</u>
TPA 60 Mil Fleece Back.....	27 Rolls.....	76” X 90’ Roll

Bidding Contractor: _____

Contractor Signature: _____

Date: _____

Compton Community College
Student Services Roof Project

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.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 06 10 00 - Rough Carpentry: Field fabricated roof curbs.
- C. Section 07 25 00 - Weather Barriers: Flexible flashing.
- D. Section 07 54 00 - Thermoplastic Membrane Roofing: Roofing system and membrane clad flashing.
- E. Section 07 72 00 - Roof Accessories: Manufactured metal roof curbs.
- F. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
- G. Section 09 91 13 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ACI 308R - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- B. AATCC Test Method 134 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
 - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
 - 1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- H. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.
- I. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.
- J. ASTM D3161/D3161M - Standard Test Method for Wind-Resistance of Steep Slope Roofing Products (Fan-Induced Method); 2016.

- K. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- L. 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 33 00 - Submittal Procedures, 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 three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. 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 gage, (0.0239 inch) thick base 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 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
 - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AATCC Test Method 134; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's custom colors.
- D. Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick; anodized finish of color as selected.
 - 1. Clear Anodized Finish: ACI 308R AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils thick.
- E. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) thick; smooth No. 4 - Brushed finish.

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. Fabricate cleats of same material as sheet, minimum 4 inches wide, except at continuous strips, interlocking with sheet.
 - 1. Typically use continuous strips.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. 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.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
 - 1. Factory-manufactured, mitered inside and outside corners.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. Splices: Factory-manufactured, integral component of reglet and flashing system.
- I. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.03 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA (ASMM), Rectangular profile.
- B. Downspouts: Rectangular profile.
- 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. Downspout Boots: Steel.
 - H. Downspout Extenders: Same material and finish as downspouts.
 - I. Seal metal joints.

2.04 ACCESSORIES

- A. 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.
- B. Adhesives: Type recommended by flexible flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
- C. Fasteners: Galvanized steel, with soft neoprene washers.
- D. Underlayment: Self-adhesive sheet flexible flashing complying with ASTM D1970/D1970M.
- E. Slip Sheet: Rosin sized building paper.
- F. Primer: Zinc chromate type.
- G. Protective Backing Paint: Zinc molybdate alkyd.
- H. Concealed Sealants: Non-curing butyl sealant.
- I. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- J. Plastic Cement: ASTM D4586/D4586M, Type I.
- K. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.
 1. 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.
 2. Specified Manufacturer: Fry Reglet Corporation, www.fryreglet.com.
 3. Acceptable Manufacturers:
 - a. O'Keefes, Inc., www.okeefes.com.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 4. 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.
- 5. Reglets:
 - a. Surface-applied, Fry Springlok Flashing System Type SM, or equal.
 - b. Recessed, Fry Springlok Flashing System Type ST, or equal.
- L. Solder: ASTM B32; Sn50 (50/50) type.

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.

3.03 INSTALLATION

- A. Conform to drawing details and the following:
 - 1. Roof - Penetration Flashing: SMACNA Architectural Sheet Metal Manual, Detail 4-13 through 4-16.
- B. 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.
- C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- D. Apply plastic cement compound between metal flashings and felt flashings.
- E. 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.
- F. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
- G. Secure gutters and downspouts in place with concealed fasteners.
- 1. Install downspouts not less than 1 inch clear from walls.
 - 2. Fasten downspouts to walls at top, bottom, and at an intermediate point not exceeding 60 inches on center, with leader straps or concealed rack-and-pin type fasteners.
- H. Connect downspouts to downspout boots, and grout connection watertight.
- I. Set splash pans under downspouts. Set in place with adhesive.
- J. 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.
- K. 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 45 00 - Quality Control, for field inspection requirements.

- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.07 SCHEDULE

- A. Gutters, Downspouts, and Scuppers: Field painted
- B. Coping, Cap, Parapet, Sill and Ledge Flashings: Thermoplastic membrane cladding.
- C. Counterflashings at Roofing Terminations (over roofing base flashings):
- D. Counterflashings at Curb-Mounted Roof Items:
- E. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: Field Painted

END OF SECTION

SECTION 07 62 70
EXTERIOR PENETRATION FLASHING PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Flashing panels to weatherproof plumbing, HVAC, and electrical penetrations in exterior walls.

1.02 RELATED SECTIONS

- A. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- B. Division 22 - Plumbing and 23 - Heating, Ventilation, & Air-Conditioning: Plumbing piping and HVAC piping or small sheet metal ducts.
- C. Division 26 - Electrical, 27 - Communications, and 28 - Electronic Safety & Security: Boxes and conduits.

1.03 REFERENCES

- A. ASTM D3763 - Standard Test Method for Density of Plastics by the Density-Gradient Technique; 2010.
- B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2015a).
- D. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
- E. ASTM D792 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2013.

1.04 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittal Procedures: Submittal Procedures.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Application Schedule: Submit a schedule of items to be used for each individual type of penetration and exterior wall finish material.
- D. Samples: Submit manufacturer's samples of flashing panels.
- E. Warranty: Submit manufacturer's standard warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage.

1.06 WARRANTY

- A. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design Product: Quickflash Weatherproofing Flashing Panels as manufactured by Quickflash Weatherproofing Products, Inc., www.quickflashproducts.com, or approved equal.
- B. Other Acceptable Manufacturers:
 - 1. Section 07 62 00 - Sheet Metal Flashing and Trim.
 - 2. None identified, submit as "or equal" per substitution requirements

2.02 FLASHING PANELS

- A. Flashing Panels: Quickflash Weatherproofing Flashing Panels.
- B. Plumbing Flashing Panels:
 - 1. Materials:
 - a. Panel: Combination of high-density polyethylene (HDPE) and low-density polyethylene (LDPE).
 - 1) HDPE, Specific Gravity, ASTM D3763: 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.
 - 2. Model: Coordinate with each trade to provide specific models correctly sized for each individual pipe or duct penetration in each application as occurs in the exterior walls of the building.
- C. 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. Model: Coordinate with each trade to provide specific models correctly sized for each individual conduit, box or panel penetration in each application as occurs in the exterior walls of the building.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive flashing panels.

- B. Notify Architect of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

- A. Copper Pipes:
 - 1. Heat sweat copper pipes before installation of flashing panels.

3.03 INSTALLATION

- A. Install flashing panels in accordance with manufacturer's instructions.
- B. Plumbing Flashing Panels, 1 Piece:
 - 1. Select flashing panel required for specific pipe sizes.
 - 2. Push flashing panel over pipe with label facing to exterior to form weatherproof seal around pipe.
 - 3. Nail flashing panels to walls with corrosion-resistant nails at top of panels.
- C. Plumbing Flashing Panels, 2 Piece:
 - 1. Cut flashing panel scores to size of pipe.
 - 2. Place bottom panel under pipe.
 - 3. Snap top panel to bottom panel over pipe.
 - 4. Caulk pipe to flashing panel with exterior polyurethane joint sealant for weatherproof seal.
- D. Electrical Flashing Panels:
 - 1. Select flashing panel required for specific electrical boxes.
 - 2. Push flashing panel over electrical box with label facing to exterior to form weatherproof seal around box.
 - 3. Ensure flashing panel collar edge is flush with electrical box opening edge.
 - 4. Nail flashing panels to walls with corrosion-resistant nails at top of panels.
- E. Weather Barriers:
 - 1. Place weather barrier up behind bottom of flashing panel to bottom of pipe or electrical box.
 - 2. Place second layer of weather barrier over top of flashing panel to bottom front edge or further down.

3.04 PROTECTION

- A. Protect installed flashing panels from damage during construction.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Curbs.
- B. Equipment rails.
- C. Roof penetrations mounting curbs.
- D. Roof hatches.
- E. Roof walkways and platforms.
- F. Non-penetrating pedestals.

1.02 RELATED REQUIREMENTS

- A. Section 05 31 00 - Steel Decking.
- B. Section 05 50 00 - Metal Fabrications.
- C. Division 07 - Thermal and Moisture Protection: Roofing System
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Guarding floor and wall openings and holes; current edition.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- H. OSHA 29 CFR 1910.23 - Fall Protection in General Industry; current edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.07 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, 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 smoke hatches.

1.08 WARRANTY

- A. Extended Warranty, Roof Hatches and Smoke Hatches: Manufacturer's standard five year warranty.

PART 2 PRODUCTS

2.01 ROOF CURBS

- A. Manufacturers:
 1. AES Industries Inc.: www.aescurb.com.
 2. Custom Curb, Inc.; Model No. CRC-3.
 3. Portals Plus: www.portalsplus.com.
 4. Thybar Corp.; Model No. TC-3; www.thybar.com
 5. The Pate Company; Model No. pc-2: www.patecurbs.com.

6. Roof Products & Systems (RPS): www.rpscubs.com.
 7. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings.
 2. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
 3. Sheet Metal Material:
 - a. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
 - 1) Finish: Factory primed.
 - 2) Color: As selected by Architect from manufacturer's standard line of colors.
 4. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches.
 5. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
 - a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch clearance between curb and metal roof panel flange allowing water to properly flow past curb.
 - b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
 - c. Maintain at least 12 inch clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
 - d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.
 6. Provide layouts and configurations indicated on drawings.
- C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
 3. Height Above Finished Roof Surface: 8 inches, minimum.
- D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
1. Height Above Finished Roof Surface: 8 inches, minimum.
 2. Provide gage of shell and size of nailers as necessary to support the full weight of the equipment.

- E. Equipment Support: Straight curbs on each side of equipment, with top of curbs parallel with metal roofing system and each other for equipment mounting.
- F. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.
 - 1. Provide sliding channel welded along top edge with adjustable height steel bracket, fabricated to fit item supported.
 - 2. Height Above Finished Roof Surface: 8 inches, minimum.

2.02 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
 - 1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
 - 2. Babcock-Davis; ThermalMAX: www.babcockdavis.com/#sle.
 - 3. BILCO Company; Type E - Ladder Access: www.bilco.com/#sle.
 - 4. Dur-Red Products: www.dur-red.com.
 - 5. JL Industries: [www.activarcpg.com/JL Industries](http://www.activarcpg.com/JL%20Industries).
 - 6. Milcor, Inc: www.milcorinc.com.
 - 7. Nystrom, Inc: www.nystrom.com/#sle.
 - 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 - 1. Style: Provide flat metal covers unless otherwise indicated.
 - 2. Mounting Substrate: Provide frames and curbs suitable for mounting on corrugated metal roof deck with insulation.
 - 3. Size: As indicated on drawings; single-leaf style unless indicated as double-leaf.
 - a. For Ladder Access: Single leaf; 36 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 gage, 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 surface of roof deck, 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 gage, 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: Manufacturer's standard accessory safety rail system mounted directly to curb.
 - 1. Comply with 29 CFR 1910.23, with a safety factor of two.
 - 2. Posts and Rails: Aluminum tube.
 - 3. Gate: Same material as railing; automatic closing with latch.
 - 4. Finish: Manufacturer's standard, factory applied finish.
 - 5. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
 - 6. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
 - 7. Fasteners: Stainless steel, Type 316.
 - 8. Manufacturers:
 - a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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.

2.03 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. Manufacturers:

- a. Metal Roof Innovations, Ltd. S-5! Attachment Solutions; S-5! Utility System: www.s-5.com/#sle.
 - b. PHP Systems/Design: www.phpsd.com.
 - c. Portals Plus: www.portalsplus.com/#sle.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Roof Walkways and Platforms: Non-penetrating, mechanically attached walkway system installed over standing seam metal roofs.
- 1. Dimensions: As indicated on drawings.
 - 2. Grating Length: Manufacturer's standard length.
 - 3. Walking Surfaces: 18 gage, 0.0478 inch hot dip galvanized steel grating at G90 in accordance with ASTM A653/A653M, either formed plank grating or welded bar grating, with anti-skid surface and handrails at locations indicated on drawings.
 - 4. Provide support plate assemblies and attachment hardware in compliance with manufacturer's written instructions in accordance with installation requirements.
 - 5. Manufacturers:
 - a. LMCurbs; Roof Walks: www.lmcurbs.com/#sle.
 - b. BlueWater Mfg., Inc.: www.bluewater-mfg.com.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. 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.
- D. Duct Supports: Provide extruded aluminum supports and sized in accordance with diameter of supported ducts, and with base that is non-penetrating of roofing membrane.
- E. 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. Manufacturers:
 - a. Metal Roof Innovations, Ltd. S-5! Attachment Solutions; S-5! Utility System: www.s-5.com/#sle.
 - b. Portals Plus; Pedestal Plus: www.portalsplus.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.04 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 60 00 - 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. 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 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Cutting and patching.
- B. Section 07 05 53 - Fire and Smoke Assembly Identification.
- C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. California Building Code: Section 714 - Penetrations and 715 - Fire Resistant Joint Systems.
- B. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
 - 1. Use 2012a as indicated in 2016 CBC Referenced Standards.
- D. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- E. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
 - 1. Use 2007a as indicated in 2016 CBC Referenced Standards.
- F. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014b.
 - 1. Use 2010ae1 as indicated in 2016 CBC Referenced Standards.
- G. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a (Reapproved 2015).
 - 1. Use 2010ae1 as indicated in 2016 CBC Referenced Standards.
- H. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015b.
 - 1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- J. ITS (DIR) - Directory of Listed Products; current edition.
- K. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- L. FM (AG) - FM Approval Guide; current edition.

- M. Firestop Contractors International Association (FCIA): M.O.P. Manual of Practice.
- N. International Firestop Council (IFC); www.firestop.org:
 - 1. Reference 1: Recommended IFC Guidelines for Evaluating Firestop Engineering Judgments.
 - 2. Reference 2: Inspectors Pocket Guide; Fifth Edition.
- O. NFPA 101 - Life Safety Code; 2015.
 - 1. Use 2015 as indicated in 2016 CBC Referenced Standards.
- P. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.
- Q. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
 - 1. Use 2003 as indicated in 2016 CBC Referenced Standards.
- R. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
 - 1. Use 2004 as indicated in 2016 CBC Referenced Standards.
- S. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- T. UL (FRD) - Fire Resistance Directory; current edition.
 - 1. UL runs ASTM E814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually with a midyear supplement.
 - 2. Through-Penetration Firestop Devices (XHCR)
 - 3. Fire Resistance Ratings (BXUV)
 - 4. Through-Penetration Firestop Systems (XHEZ)
 - 5. Fill, Voids, or Cavity Material (XHHW)
 - 6. Forming Materials (XHKU)
- U. UL Qualified Firestop Contractor Program

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Certificate from authority having jurisdiction indicating approval of materials used.
- H. Installer Qualification: Submit qualification statements for installing mechanics.

1.05 QUALITY ASSURANCE

- A. Provide products for all trades from the same manufacturer to the greatest extent possible and from the same supplier/distributor.
- B. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - 1. One firestop manufacturer shall be used for the entirety of applications on this project unless otherwise approved by the Architect. The manufacturer will be required to furnish UL tested systems for all applications pertaining to the project, in addition to material safety data sheets and all other relevant information.
 - a. Materials of different manufacture than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.
 - b. Tested and listed firestop systems are to be used before an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRRA) is installed.
 - 2. A manufacturer's knowledgeable direct representative (manufacturer authorized; distributor, independent representative, manufacturer's representative, or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- D. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Trained by manufacturer.
 - 2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - a. UL Qualified Firestop Contractor
 - b. Verification of minimum three years documented experience installing work of this type.
 - c. Shown to have successfully completed not less than 5 comparable scale projects.
 - d. Verification of at least five satisfactorily completed projects of comparable size and type.
 - e. Firestop Contractors International Association Contractor Member in good standing.
 - f. Licensed by local authorities having jurisdiction (AHJ).

1.06 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.

1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
- B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
- C. If accepted, mock-up will represent minimum standard for the Work.
- D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 1. Basis of Design: Specified Technologies, Inc: www.stifirestop.com/#sle.
 2. 3M Fire Protection Products: www.3m.com/firestop.
 3. A/D Fire Protection Systems Inc: www.adfire.com.
 4. Hilti, Inc: www.us.hilti.com/#sle.
 5. Nelson FireStop Products: www.nelsonfirestop.com.
 6. Rectorseal; Bio FireShield and Metacaulk Systems: www.rectorseal.com.
 7. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.
 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 REGULATORY REQUIREMENTS

- A. Firestop System installation must meet requirements of ASTM E814, ASTM E2307, ASTM E1966 and UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
 1. Positive pressure in accordance with California Building Code (CBC) for ratings. Reference: CBC Section 714.3.1.2.
 2. Comply with UL Standard 2079 for top of wall assemblies.
 3. Conform to CBC Section 714.3.1.1 and 714.3.2.
- B. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

2.03 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- E. Fire Ratings: Refer to drawings for required systems and ratings.

2.04 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 - 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 - 3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
 - 4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.05 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Penetrations By:
 - 1. Penetrations by Structural Struts, Cables or Threaded Rod:
 - a. 1 and 2 Hour Wall Construction: UL System W-L-7136; F Rating: 1 and 2 Hour; T Rating: 0 Hour; SpecSeal Series SSS Sealant, SpecSeal LCI Sealant, SpecSeal LC150 Sealant, or SpecSeal LE600 Sealant.
 - 2. Multiple Penetrations in Large Openings:
 - a. 1, 2, 3, and 4 Hour Wall Construction with EZ Path: UL System W-L-3377; F Rating: 1, 2, 3, and 4 Hour; T Rating: 0, 1/2, 3/4, 1, 1-1/2, and 2 Hour; Firestop Device: EZ PATH Series 22, 33 or 44+ Fire Rated Pathway, optional steel sleeve.
 - b. 1 and 2 Hour Wall Construction: UL System W-L-8026; F Rating: 1 and 2 Hour; T Rating: 0, 1/2, 1, 1-3/4 and 2 Hour; mineral wool packing with SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - c. 1 and 2 Hour Wall Construction: UL System W-L-1168; F Rating: 1 and 2 Hour; T Rating: 1/4, 3/4 and 1 Hour; SpecSeal LC150 Sealant, SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - d. 1 and 2 Hour Wall Construction: UL System W-L-3214; F Rating: 1 and 2 Hour; T Rating: 1/4, 3/4 and 1 Hour; SpecSeal LC150 Sealant, SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - e. 1 and 2 Hour Wall Construction: UL System W-L-8027; F Rating: 1 and 2 Hour; T Rating: 1/4 Hour; SpecSeal LCI Sealant.
 - 3. Uninsulated Metallic Pipe, Conduit, and Tubing:

- a. 1 and 2 Hour Wall Construction: UL System W-L-1049; F Rating: 1 and 2 Hour; T Rating: 0 Hour; SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - b. 1 and 2 Hour Wall Construction: UL System W-L-1222; F Rating: 1 and 2 Hour; T Rating: 1/4, 3/4 and 1 Hour; SpecSeal LCI Sealant.
 - c. 1 and 2 Hour Wall Construction: UL System W-L-1049; F Rating: 1 and 2 Hour; T Rating: 0 Hour; SpecSeal 100, 101, 102, 105, 120 or 129 Sealant, SpecSeal LCI Sealant.
4. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
- a. 1 and 2 Hour Wall Construction with pipe clamp ring: UL System W-L-2029; F Rating: 1 and 2 Hour; T Rating: 1, 1-1/2 and 2 Hour; SpecSeal Firestop Collar, SpecSeal LCC Collar.
 - b. 1 and 2 Hour Wall Construction: UL System W-L-2100; F Rating: 1 and 2 Hour; T Rating: 0, 1/4, 1 and 1-1/2 Hour; SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - c. 1 and 2 Hour Wall Construction: UL System W-L-2241; F Rating: 1 and 2 Hour; T Rating: 0, 1/4, 1, and 1-3/4 Hour; SpecSeal LCI Sealant.
 - d. 1 and 2 Hour Wall Construction: UL System W-L-2548; F Rating: 1 and 2 Hour; T Rating: 0 Hour; SpecSeal LCI Sealant or SpecSeal Series SSS Sealant.
5. Electrical Cables Not In Conduit:
- a. 1 and 2 Hour Wall Construction: UL System W-L-3169; F Rating: 1 and 2 Hour; T Rating: 1/4 and 3/4 Hour; SpecSeal LCI Sealant.
 - b. 1 and 2 Hour Wall Construction: UL System W-L-3210; F Rating: 1 and 2 Hour; T Rating: 3/4 Hour; mineral wool packing with SpecSeal Series SSS Sealant, SpecSeal LCI Sealant or SpecSeal Putty.
6. Cable Trays with Electrical Cables:
- a. 2 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
 - b. 1 and 2 Hour Wall Construction: UL System W-L-4074; F Rating: 1 and 2 Hour; T Rating: 1/4, 1/2, 1 and 1-1/4 Hour; mineral wool packing with SpecSeal LCI Sealant.
 - c. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
7. Insulated Pipes:
- a. 1 and 2 Hour Wall Construction: UL System W-L-5014; F Rating: 1 and 2 Hour; T Rating: 1 Hour; SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - b. 1 and 2 Hour Wall Construction: UL System W-L-5054; F Rating: 1 and 2 Hour; T Rating: 3/4 and 1 Hour; SpecSeal Series SSS Sealant or SpecSeal LCI Sealant.
 - c. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
 - e. 1 Hour Construction: UL System W-L-5096; Hilti FS-ONE Intumescent Firestop Sealant.
 - f. 1 Hour Construction: UL System W-L-5096; Hilti FS-ONE Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, or CP 601S Elastomeric Firestop Sealant.
8. HVAC Ducts, Uninsulated:

- a. 1 and 2 Hour Wall Construction with up to 100 x 100 inch duct: UL System W-L-7025; F Rating: 1 and 2 Hour; T Rating: 1/2 Hour; Polyethylene backer rod or mineral wool packing with SpecSeal Series SSS Sealant, SpecSeal LCI Sealant, SpecSeal LC150 Sealant or SpecSeal LE 600 Sealant.
 - b. 1 and 2 Hour Wall Construction with up to 24 inch round duct: UL System W-L-7026; F Rating: 1 and 2 Hour; T Rating: 0 Hour; Polyethylene backer rod or mineral wool packing with SpecSeal Series SSS Sealant, SpecSeal LCI Sealant, SpecSeal LC150 Sealant or SpecSeal LE 600 Sealant.
 - c. 1 and 2 Hour Wall Construction with up to 24 x 24 inch duct: UL System W-L-7029; F Rating: 1 and 2 Hour; T Rating: 1/4 Hour; Polyethylene backer rod or mineral wool packing with SpecSeal Series SSS Sealant, SpecSeal LCI Sealant, SpecSeal LC150 Sealant or SpecSeal LE 600 Sealant.
9. HVAC Ducts, Insulated:
- a. 1 and 2 Hour Wall Construction with up to 20 inch round duct: UL System W-L-7179; F Rating: 1 and 2 Hour; T Rating: 3/4 Hour; SpecSeal Series SSS Sealant, or SpecSeal LCI Sealant.
 - b. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.06 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 SEQUENCING AND SCHEDULING

- A. Project coordination is essential to inform and educate all the parties involved with the firestopping process of their role and how they can affect firestopping on the project. A pre-construction meeting shall be scheduled and required for all parties involved prior to the start of construction.
- B. Do not cover up firestopping installations until District's inspection agency or the Authorities Having Jurisdiction have examined each installation.

3.02 EXAMINATION

- A. Verify openings are ready to receive the work of this section.
- B. Pre-Installation Inspection: Inspect all fire and smoke barriers for penetrations of any type; mark or otherwise identify all penetrations indicating action required: 1) repair; 2) firestopping; or 3) smokestopping.
 - 1. Conduct inspection prior to covering up or enclosing walls or ceilings.
 - 2. Conduct inspection jointly with authorized representative of authority having jurisdiction.

- C. If the configuration of a particular penetration does not conform to the configuration necessary for the required firestopping assembly:
 - 1. Notify the installer of the penetration for modification of the configuration to suit the assembly.
 - 2. Do not use the firestopping assembly in other configurations except as specifically stated in the test report or as approved by the authority having jurisdiction.

3.03 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.
- D. Priming:
 - 1. Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods.
 - 2. Confine primers to areas of bond.
 - 3. Do not allow spillage and migration onto exposed surfaces.
- E. Masking Tape:
 - 1. Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work.
 - 2. Remove tape as soon as it is possible to do so without disturbing the firestopping seal with substrates.
- F. Verify that system components are clean, dry, and ready for installation.
- G. Verify that field dimensions are as shown on the Drawings and as recommended by the manufacturer.
- H. Prepare penetrations in accordance with the material manufacturer's instructions.
- I. Ventilation: Ventilate per firestopping manufacturers' instructions or Material Safety Data Sheet (MSDS).

3.04 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
 - 1. Provide all accessory materials.
- B. Do not cover installed firestopping until inspected by District's Independent Testing Agency.
- C. Penetration Firestops:
 - 1. Coordinate with other trades to assure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
 - 2. Schedule the work to assure that partitions and all other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.

3. Install forming/damming materials and other accessories in accordance with manufacturers written instructions.
4. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - a. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - b. Install materials so they contact and adhere to substrates formed by openings and penetrating items.
5. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces
- D. Remove combustible forming materials, unless they are a required component of the tested assembly.
- E. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- F. Install labeling required by code; 07 05 53 - Fire and Smoke Assembly Identification.
 1. Near fire and smoke barriers, mark each exposed penetration with label identifying it as a fire-stopped or smoke-stopped assembly.

3.05 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by District, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- B. The inspector shall advise the Contractor of any deficiencies noted within one (1) working day.
- C. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.
- D. Do not proceed to enclose firestopping with other construction until inspection agency has verified that the firestop installation complies with the requirements.
- E. Submit report of inspection to the Construction Manager and Architect.

3.06 CLEANING

- A. Hazardous disposal of firestop materials shall be strictly observed as noted on the individual MSDS.
- B. Clean adjacent surfaces of firestopping materials.
 1. Clean up excess material adjacent to penetrations promptly; use methods and materials approved by the manufacturers of the penetration seals and of surfaces to be cleaned.

3.07 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.
- B. Protect firestopping during and after curing period from contact with contaminating substances.
- C. Protect installed Work from damage from construction operations using substantial barriers as necessary.

D. Repair damaged materials in accordance with manufacturer's instructions.

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 07 25 00 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
- B. Section 07 84 00 - Firestopping: Firestopping sealants.
- C. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.
- D. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- E. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.
- F. Division 23 - Heating, Ventilation and Air-Conditioning (HVAC): Duct sealants.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
- B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015a.
- C. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.
- J. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015.
- K. SWRI (VAL) - SWR Institute Validated Products Directory; Current Listings at www.swrionline.org.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes 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. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 7. Sample product warranty.
 - 8. Certification by manufacturer indicating that product complies with specification requirements.
 - 9. 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.

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 to manufacturer sufficient samples 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 acknowledgement 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 as "No primer" 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 manufacturers' 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. Non-destructive 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 inch intervals at no extra cost to District.
 3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1000 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. Non-Destructive 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 inch 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 prior to minimum elongation, take necessary measures to correct conditions and re-test; 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 other applicable method as recommended by manufacturer.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Adhesives Technology Corporation: www.atcepoxy.com.
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Dow Corning Corporation: www.dowcorning.com/construction/sle.
 - 4. Fortifiber Building Systems Group: www.fortifiber.com/sle.
 - 5. Hilti, Inc: www.us.hilti.com/#sle.
 - 6. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/sle.
 - 7. Pecora Corporation: www.pecora.com.
 - 8. The QUIKRETE Companies: www.quikrete.com.
 - 9. Sherwin-Williams Company: www.sherwin-williams.com.
 - 10. Sika Corporation: www.usa-sika.com.
 - 11. Specified Technologies Inc: www.stifirestop.com/#sle.
 - 12. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 13. W.R. Meadows, Inc: www.wrmeadows.com/sle.
 - 14. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
 - 1. Adhesives Technology Corporation: www.atcepoxy.com.
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Dayton Superior Corporation: www.daytonsuperior.com.
 - 4. Dow Corning Corporation: www.dowcorning.com/construction/sle.
 - 5. Pecora Corporation: www.pecora.com.
 - 6. The QUIKRETE Companies: www.quikrete.com.
 - 7. Sherwin-Williams Company: www.sherwin-williams.com.
 - 8. Sika Corporation: www.usa-sika.com.
 - 9. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 10. W.R. Meadows, Inc: www.wrmeadows.com/sle.
 - 11. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Such gaps and openings in gypsum board finished stud walls and suspended ceilings.
 - 2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - c. Other joints indicated below.
 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Type EP-1 - Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Type SM-1 - Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
 2. Type SM-1 - Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
 3. Type CP-1 - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
- C. Type IP-1 - Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Type IA-1 - Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 2. Type WP-1 - Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
 3. Type WP-1 - Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
 4. Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Non-sag tamper-resistant silyl-terminated polyurethane sealant.

5. Type FS-1 - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 6. Type IA-1 - In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 7. Type EPX-1 - Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
 8. Type WFP-1 - Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: restrooms and kitchens; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
 - E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".
 - F. Areas Where Tamper-Resistance is Required: As indicated on drawings.

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content of SCAQMD.
- B. Colors: As indicated on the drawings. Match adjacent surface.

2.04 NONSAG JOINT SEALANTS

- A. Type NS-1 - Non-Staining 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. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's full range.
 4. Cure Type: Single-component, neutral moisture curing.
 5. Service Temperature Range: Minus 65 to 180 degrees F.
 6. Manufacturers:
 - a. Dow Chemical Company; 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - b. Dow Chemical Company; 791 Silicone Weatherproofing Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - c. Dow Chemical Company; 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - d. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/sle.
 - e. Pecora Corporation: www.pecora.com.
 - f. Sika Corporation; Sikasil WS-290: www.usa-sika.com/#sle.
 - g. Sika Corporation; Sikasil WS-295: www.usa-sika.com/#sle.
 - h. Tremco Commercial Sealants & Waterproofing; Spectrem 2: www.tremcosealants.com/#sle.
 - i. Tremco Commercial Sealants & Waterproofing; Spectrem 3: www.tremcosealants.com/#sle.

- j. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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. Color: To be selected by Architect from manufacturer's full range.
 - 3. Cure Type: Single-component, neutral moisture curing
 - 4. Service Temperature Range: Minus 65 to 180 degrees F.
 - 5. Manufacturers:
 - a. Fortifiber Building Systems Group; Moistop Sealant: www.fortifiber.com/#sle.
 - b. Dow Chemical Company; 758 Silicone Weather Barrier Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - c. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/sle.
 - d. Pecora Corporation: www.pecora.com.
 - e. Sherwin-Williams Company; Silicone Rubber All Purpose Sealant: www.sherwin-williams.com/#sle.
 - f. Sika Corporation; Sikasil GP: www.usa-sika.com/#sle.
 - g. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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. Manufacturers:
 - 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: www.pecora.com.
 - e. Sika Corporation; Sikasil GP: www.usa-sika.com/#sle.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Type ST-1 - Silyl-Terminated Polyether (STPE) and Polyurethane (STPU) 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 35 percent, minimum.
 - 2. Hardness Range: 20 to 40, 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 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. Sherwin-Williams Company; Stampede 100 Low-Modulus Hybrid Urethane Sealant: www.sherwin-williams.com/#sle.

- b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- E. Tamper-Resistant, Silyl-Terminated Polyurethane (STPU) 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 12-1/2 percent, minimum
 - 2. Hardness Range: 25 to 30, 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 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Sika Corporation; SikaHyflex-150 LM: www.usa-sika.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- F. Type PS-1 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-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 full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. The QUIKRETE Companies; QUIKRETE® Polyurethane Non-Sag Sealant: www.quikrete.com/#sle.
 - b. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant: www.sherwin-williams.com/#sle.
 - c. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
 - d. Sika Corporation; Sikaflex-15 LM: www.usa-sika.com/#sle.
 - e. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC: www.tremcosealants.com/#sle.
 - f. W. R. Meadows, Inc; POURTHANE NS: www.wrmeadows.com/#sle.
 - g. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- G. Non-Sag "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: 40 to 50, 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 40 to 180 degrees F.
- H. Tamper-Resistant Polyurethane Sealant: ASTM C920, Grade NS, Uses M, G, and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
 - 2. Hardness Range: 50 to 60, 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 40 to 180 degrees F.
- I. Epoxy Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Hardness Range: 65 to 75, Shore A, when tested in accordance with ASTM C661.
 2. Color: To be selected by Architect from manufacturer's full range.
 3. Service Temperature Range: Minus 40 to 180 degrees F.
 4. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- J. Polysulfide Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-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 full range.
 4. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. W.R. Meadows, Inc; Deck-O-Seal Gun Grade: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- K. Polysulfide Sealant for Continuous Water Immersion: Polysulfide; ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; not expected to withstand 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 full range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Manufacturers:
 - a. Pecora Corporation; Synthacalk GC2+: www.pecora.com/#sle.
 - b. W.R. Meadows, Inc; Deck-O-Seal Gun Grade: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- L. Acrylic-Urethane Sealant: Water-based; ASTM C920, Grade NS, Uses M and A; single component; paintable; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
 2. Hardness Range: 20 to 40, Shore A, when tested in accordance with ASTM C661.
 3. Color: White.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Manufacturers:
 - a. Sherwin-Williams Company; Shermax Urethanized Elastomeric Sealant: www.sherwin-williams.com/#sle.

- b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- M. Type 1A-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
 - 1. Color: To be selected by Architect from manufacturer's full range.
 - 2. Grade: ASTM C834; Grade - Minus 18 Degrees C.
 - 3. Manufacturers:
 - a. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com/#sle.
 - b. Hilti, Inc; CP 572 Smoke and Acoustical Spray Sealant: www.us.hilti.com/#sle.
 - c. Pecora Corporation: www.pecora.com.
 - d. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - e. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant: www.stifirestop.com/#sle.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- N. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.05 SELF-LEVELING 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 full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. Sika Corporation; Sikasil 728SL: www.usa-sika.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Type P-1 - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; 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 full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. The QUIKRETE Companies; QUIKRETE® Polyurethane Self-Leveling Sealant: www.quikrete.com/#sle.

- c. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: www.sherwin-williams.com/#sle.
 - d. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com/#sle.
 - e. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Type WFP-1 - Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-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 full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com/#sle.
 - b. W. R. MEADOWS, Inc; POURTHANE SL: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Self-Leveling Silyl-Terminated Polyether/Polyurethane (STPE/STPU) Sealant: ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
 - 1. Movement Capability: Plus and minus 35 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. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- E. 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 full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Manufacturers:
 - a. W.R. Meadows, Inc; Deck-O-Seal (pourable): www.wrmeadows.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- F. 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. Manufacturers:

- a. ARDEX Engineered Cements; ARDEX ARDIFIX: www.ardexamericas.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- G. 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: Multi-component, 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: To be selected by Architect from manufacturer's standard colors.
 - 4. Joint Width, Minimum: 1/8 inch.
 - 5. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
 - 6. Manufacturers:
 - a. Dayton Superior Corporation; Pro-Poxy P606: www.daytonsuperior.com/#sle.
 - b. Nox-Crete; DynaFlex 502: www.nox-crete.com/#sle.
 - c. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- H. 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 Depth: Provide product suitable for joints from 1/8 inch to 1 inch in depth excluding space for backer rod.
 - 5. Manufacturers:
 - a. Adhesives Technology Corporation; Crackbond JF-311: www.atcepoxy.com/#sle.
 - b. ARDEX Engineered Cements; ARDEX ARDISEAL RAPID PLUS: www.ardexamericas.com/#sle.
 - c. Nox-Crete; DynaFlex JF-85: www.nox-crete.com/#sle.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

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 7 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 whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
6. After completion of tests, remove remaining sample material and prepare joint 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.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. 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.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. 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.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

- A. District will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.

- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. 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.

END OF SECTION

SECTION 08 06 71
DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule of door hardware sets for swinging and other door types 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; 2016.
- B. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- C. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
- D. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2012.
- E. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.
- F. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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.
- 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. AA - ASSA High Security Locks
 - 2. AD/AR - Adams Rite, Assa Abloy Door Security Solutions.
 - 3. BM - Besam, Assa Abloy Door Security Solutions.
 - 4. CR - Corbin Russwin, Assa Abloy Door Security Solutions.
 - 5. CUR - Curries, Assa Abloy Door Security Solutions.
 - 6. HES - HES, Assa Abloy Door Security Solutions.
 - 7. HD - HID Global, Assa Abloy Door Security Solutions.

8. McK/MK - McKinney, Assa Abloy Door Security Solutions.
9. MR/MKR - Markar.
10. NO/NOR - Norton.
11. PEM/PE - Pemko, Assa Abloy Door Security Solutions.
12. RIX/RF - Rixson Specialty Door Controls, Assa Abloy Door Security Solutions.
13. ROC/RO - Rockwood.
14. SA - Sargent, Assa Abloy Door Security Solutions.
15. SEC/SU - Securitron, Assa Abloy Door Security Solutions.
16. ST/SDC - Stanley Door Closers, Dormakaba.
17. ST/SH - Stanley Hinges, Dormakaba.
18. ST/STH - Stanley Commercial Hardware, Stanly Works.
19. YA - Yale, Assa Abloy Door Security Solutions.
20. TBD - To be determined.
21. 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.

2.04 FINISHES

- 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. No hardware shall be ordered 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. Contractor shall verify all door quantities with the Architectural Drawings.

Hardware Sets

Set: 1.0

Doors: 001, 006, 150

Description: Automatic Alum Sliders

1 Sliders	By Mfr		00
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Set: 2.0

Doors: 002, 003, 004, 005, 007, 012

Description: Exterior Sgl - Panic - CR

1 Continuous Hinge	FM300 WEP	630	MR	
1 Exit Device (nightlatch)	5CH LC 16 43 8804 x 525 edge guard on touch pad	US32D	SA	
2 Cylinder as req'd	to match existing facility std		AA	
1 Electric Strike	9500	630	HS	
1 Vandal Resistant Trim	VRT24 C	US32D	RO	
1 Concealed Overhead Stop	1-X36(as req'd in lieu of wall / floor stop)	630	RF	
1 Door Closer	351 P10	EN	SA	
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1 Threshold	Per Sill Detail		PE	
1 Rain Guard	346C (omit @ overhang)		PE	
1 Gasketing	2891APK		PE	
1 Sweep	18062CNB		PE	
1 Position Switch	DPS		SU	
1 Power Supply	BPS-24		SU	

Notes: Card Reader, wiring and electrical interface by Security Contractor

Operational Narrative: Door normally closed and locked. Upon presentation of valid credential, door will momentarily unlock. Free egress at all times. In the event of activation of the Fire alarm or loss of power, doors will remain closed and locked.

Set: 3.0

Doors: 131, 132, 171, 181

Description: Interior sgl Study / Huddle

3 Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1 Passage Set	8215 LNP	US26D	SA
1 Concealed Overhead Stop	1-X36(as req'd in lieu of wall / floor stop)	630	RF
1 Wall Stop	403	US26D	RO

Set: 4.0

Doors: 008, 009, 010, 011, 014

Description: Exterior Sgl - CR

1 Continuous Hinge	FM300 CTP WEP	630	MR
1 Fail Secure Electric Lock	LC RX 8271-24V LNP	US26D	SA ⚡
1 Cylinder as req'd	to match existing facility std		AA
1 Concealed Overhead Stop	1-X36(as req'd in lieu of wall / floor stop)	630	RF
1 Door Closer	351 P10	EN	SA
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO
1 Door Stop	466	Black	RO
1 Threshold	Per Sill Detail		PE
1 Rain Guard	346C (omit @ overhang)		PE
1 Gasketing	2891APK		PE
1 Sweep	18062CNB		PE
1 Electric Power Transfer	CEPT-10		SU ⚡
1 ElectroLynx Harness	QC-C1500P		MK ⚡
1 ElectroLynx Harness	QC-C400P		MK ⚡
1 Position Switch	DPS		SU ⚡
1 Power Supply	BPS-24		SU ⚡

Notes: Card reader, wiring and electrical interface by Security Contractor

Set: 5.0

Doors: 180A, 180B, 250A, 250B

Description: Interior Sgl Classroom Sec

3 Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1 Classroom Security Lock	LC 8238 LNP	US32D	SA
1 Cylinder as req'd	to match existing facility std		AA
1 Door Closer	351 O/P9	EN	SA
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO
1 Wall Stop	403	US26D	RO

Set: 7.0

Doors: 168, 170, 280A, 280B

Description: Interior Sgl - half door

2 Hinge (spring)	1502 4-1/2" x 4-1/2"	US26D	MK
1 Passage Set	8215 LNP	US26D	SA
1 Wall Stop	403	US26D	RO

Set: 9.0

Doors: 113, 114, 116, 122, 130, 140, 141A, 161, 162, 163, 180, 182, 211, 212, 220, 230, 240, 270, 290

Description: Interior Sgl - CR

3 Hinge (heavy weight)	T4A3786 (NRP) QCW	US26D	MK	⚡
1 Fail Secure Electric Lock	LC RX 8271-24V LNP	US26D	SA	⚡
1 Cylinder as req'd	to match existing facility std		AA	
1 Concealed Overhead Stop	1-X36(as req'd in lieu of wall / floor stop)	630	RF	
1 Door Closer	351 O/P9	EN	SA	
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1 Wall Stop	403	US26D	RO	
1 ElectroLynx Harness	QC-C1500P		MK	⚡
1 ElectroLynx Harness	QC-C400P		MK	⚡
1 Position Switch	DPS		SU	⚡
1 Power Supply	BPS-24		SU	⚡

Notes: Card Reader, wiring and electrical interface by Security Contractor

Operational Narrative: Door normally closed and locked. Upon presentation of valid credential, door will momentarily unlock. Free egress at all times. In the event of activation of the Fire alarm or loss of power, doors will remain closed and locked.

Set: 10.0

Doors: 109, 110, 207, 208

Description: Interior Sgl - CR

3 Hinge (heavy weight)	T4A3786 (NRP) QCW	US26D	MK	⚡
1 Fail Secure Electric Lock	LC RX 8271-24V LNP	US26D	SA	⚡
1 Cylinder as req'd	to match existing facility std		AA	
1 Concealed Overhead Stop	1-X36(as req'd in lieu of wall / floor stop)	630	RF	
1 Door Closer	351 O/P9	EN	SA	
1 Mop Plate	K1050 6" high 4BE CSK	US32D	RO	
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1 Wall Stop	403	US26D	RO	
1 ElectroLynx Harness	QC-C1500P		MK	⚡
1 ElectroLynx Harness	QC-C400P		MK	⚡
1 Position Switch	DPS		SU	⚡
1 Power Supply	BPS-24		SU	⚡

Notes: Card Reader, wiring and electrical interface by Security Contractor

Operational Narrative: Door normally closed and locked. Upon presentation of valid credential, door will momentarily unlock. Free egress at all times. In the event of activation of the Fire alarm or loss of power, doors will remain closed and locked.

Set: 11.0

Doors: 105, 204, 204A

Description: Interior Sgl - Privacy

3 Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK	
1 Privacy Lock	LB 49 8265 LNP	US26D	SA	
1 Door Closer	351 O/P9	EN	SA	
1 Mop Plate	K1050 6" high 4BE CSK	US32D	RO	
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1 Wall Stop	403	US26D	RO	

Notes:

Set: 12.0

Doors: 103, 104, 202, 203

Description: Interior Sgl Multi-Occup toilet

3 Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1 Passage Set	8215 LNP	US26D	SA
1 Concealed Overhead Stop	1-X36(as req'd in lieu of wall / floor stop)	630	RF
1 Door Closer	351 O/P9	EN	SA
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO
1 Wall Stop	403	US26D	RO

Set: 13.0

Doors: 102, 111, 135, 136, 152, 153, 159, 172, 173, 183, 186, 205, 206, 209, 271, 281, 281A, 291

Description: Interior Sgl Janitor / Elev Mach / Stor

3 Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1 Storeroom Lock	LC 8204 LNP	US26D	SA
2 Cylinder as req'd	to match existing facility std		AA
1 Door Closer	351 H	EN	SA
1 Kick Plate	K1050 10" 4BE CSK	US32D	RO

Set: 14.0

Doors: 133, 134, 141, 144, 145, 146, 151, 154, 155, 156, 157, 158, 160, 174, 175, 176, 177, 184, 185, 220A, 221, 231, 232, 233, 234, 241, 242, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 282, 283, 284, 285, 286, 287, 287A, 288, 289, 292, 293

Description: Interior Sgl Office

3 Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1 Office Lock	LC 8205 LNP	US26D	SA
1 Cylinder as req'd	to match existing facility std		AA
1 Wall Stop	403	US26D	RO
3 Silencer	608		RO

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. Sound-rated hollow metal doors and frames.
- F. Hollow metal borrowed lites glazing frames.
- G. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors: Wood doors to be installed in steel frames specified in this section.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- D. Section 09 91 13 - Exterior Painting: Field painting.
- E. 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. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames; 2012.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

- G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- J. 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; 2015.
- K. 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).
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
 - 1. Use 2009 as indicated in 2016 CBC Referenced Standards.
- N. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- O. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- P. ITS (DIR) - Directory of Listed Products; current edition.
- 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 Installation and Storage of Hollow Metal Doors and Frames; 2007.
- T. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.
- U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- V. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- W. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
 - 1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- X. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- Y. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- Z. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
 - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- AA. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
 - 1. Use 2009 as indicated in 2016 CBC Referenced Standards.

- AB. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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. Samples: Submit two samples of metal, 2 inch by 2 inch in size showing factory finishes, colors, and surface texture.
- E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: www.steeldoor.org/sdicertified.php.
- 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 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 716.5.3.1.
 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 716.5.7.

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. Security Metal Products; www.secmet.com.

4. Substitutions: Not permitted.

2.03 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed 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 ADAAG 2010 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.
 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers 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 (galvannealed) 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 NAAMM HMMA Custom Guidelines: Provide at least A25/ZF75 (galvannealed) for interior applications, and at least A60/ZF180 (galvannealed) or G60/Z180 (galvanized) for corrosive locations.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. 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. Basis of Design Product: 777E Trio-E Series as manufactured by Curries, or approved equal.
 2. 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 gage, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
3. Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 4. Door Thermal Resistance: U-factor of 0.70 maximum.
 - 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.
 5. Door Thickness: 1-3/4 inch, nominal.
 6. 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. Basis of Design Product: 707 Series as manufactured by Curries, or approved equal.
 2. 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: 18 gage, 0.042 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 3. Door Core Material: Manufacturer's standard core material/construction and in compliance with requirements.
 4. Door Thickness: 1-3/4 inch, 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 B, 500,000 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. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - c. Attach fire rating label to each fire rated unit.
 - d. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and

NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;

- 1) Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 - 2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
 - 3) Label: Include the "S" label on fire-rating label of door.
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.
 - b. Fabricate labeled fire resistive doors at stairwells, exit passageways, and horizontal exits with mineral fiberboard composite core that will provide the specified maximum transmitted temperature end point.
 4. Door Thickness: 1-3/4 inch, nominal.
- E. Sound-Rated Interior Doors:
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 1 - Full Flush.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 2. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 35, minimum, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
 3. Door Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
 4. Door Thickness: As required to meet acoustic requirements indicated.
 5. Opening Force of Sound-Rated Doors, Non-Fire Rated: 5 lbs, maximum, in compliance with ADA Standards.

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. Basis of Design Product: CM Series as manufactured by Curries, or approved equal.
- C. Frame Finish: Same as hollow metal door.
- D. 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: 14 gage, 0.067 inch, minimum.
 3. Weatherstripping: Separate, see Section 08 71 00.
- E. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.

1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
 - a. Openings over 48 inches: 14 gage, 0.067 inch, minimum.
- F. Door Frames, Fire-Rated: Full profile/continuously welded type.
 1. Fire Rating: Same as door, labeled.
 2. Fire rated frames require metal applied label indicating rating designation.
 3. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- G. Sound-Rated Door Frames: Full profile/continuously welded type.
 1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- H. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- I. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- J. Borrowed Lites Glazing Frames: 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. 16 gage 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.
- K. Transom Bars: Fixed, of profile same as jamb and head.
- L. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- M. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.

2.06 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- C. 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.
- D. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

2.07 ACCESSORIES

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
 - 1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
 - 2. Style: Sightproof inverted Y blade.
 - a. Fixed: Where indicated, provide fixed louvers consisting of inverted blades, formed of not lighter than 18 gage steel, welded or tenoned to 18 gage steel frames. Form louvers of same material specified for stiles and rails.
 - 3. Size: 20 x 12 inch
 - 4. Moldings:
 - a. Not lighter than 18 gage galvanized steel moldings, or 18 gage hot or cold rolled steel moldings.
 - b. Moldings shall be nonremovable on exterior or corridor side of door.
 - c. Form moldings for exterior doors of hot dip galvanized steel.
 - 5. Fasteners: Exposed, tamper proof fasteners.
 - 6. Insect Screens: Provide with 18 by 14 mesh bronze insect screen fabric in a zinc coated steel, rewireable frame finished to match the door.
- B. Glazing: As specified in Section 08 80 00.
- C. 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.
- D. Astragals for Double Doors: Specified in Section 08 71 00.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. 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) 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.

- G. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- H. 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.
- I. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
 - 1. Provide all frames with frame spreader at bottom to insure frame integrity during shipping.
- J. 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.
- B. Reinforce all frames for surface mounted hardware and cut-out, drilled and tapped to receive mortised hardware.
- C. Coat inside of exterior frames with bituminous coating to a thickness of 1/16 inch.

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 HMMMA 861.
- E. Comply with glazing installation requirements of Section 08 80 00.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Welded Steel Frames Installation:

1. Install frame solid in the wall, plumb and square, with proper opening width and height.
 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.
- H. Doors Installation, General: Hang doors and adjust for proper clearances and operation. Refer to Section 08 71 00 - Door Hardware for hardware requirements.
- I. Window Installation, General: Place glazing and adjust for proper clearances. Refer to Section 08 80 00 - Glazing for Installation requirements.
- J. 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.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

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.
- B. Transom panels.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 43 13 - Aluminum-Framed Storefronts.
- C. Section 08 71 00 - Door Hardware.
- D. Section 08 80 00 - Glazing.
- E. Section 09 91 23 - Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. Project Type:
 - 1. Public
- B. Code agency:
 - 1. California Building Code
 - 2. DSA
- C. 28 CFR 35 - Structural Sealant Glazing Systems; 1985 (R2006).
- D. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- F. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
 - 1. Use 2016 as indicated in 2016 CBC Referenced Standards.
- H. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
 - 1. Use 2009 as indicated in 2016 CBC Referenced Standards.
- J. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
 - 1. Use 2001 with revisions as indicated in 2016 CBC Referenced Standards.
- K. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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.
- D. Samples: Submit two samples of door construction, 10 by 10 inch in size cut from top corner of door.
- E. Samples: Submit two samples of door veneer, 12 by 12 inch in size illustrating wood grain, stain color, and sheen.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- H. Manufacturer's Installation Instructions: Indicate special installation instructions.
- I. Specimen warranty.
- J. 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 the past 5 years with value of woodwork within 20 percent of cost of woodwork for this 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.

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. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product: GPD PC and GPD FD as manufactured by Graham.
- B. Wood Veneer Faced Doors:
 - 1. Graham Wood Doors: www.grahamdoors.com/#sle.
 - 2. Substitutions: Not permitted.

2.02 DOORS AND PANELS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Level: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Exterior Doors: Flush solid core construction and water repellent treated.
 - 1. Thickness: 1-3/4 inches, unless otherwise indicated.
 - 2. Facing: Maple veneer with factory transparent finish as indicated on drawings.
- C. 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 716.5.1.
 - 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; if necessary, provide additional gasketing or edge sealing.
 - a. Comply with CBC Section 716.5.3.1.
 - 4. Sound-Rated Doors: Minimum STC as indicated on drawings, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 - 5. White Maple, Premium Grade, Quarter Sliced, Balanced Matched veneer facing with factory transparent finish.
 - 6. Hardboard facing for field opaque finish as indicated on drawings.
- D. Transom Panels: Same construction and finish as door; same performance rating as door.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), 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.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White Maple, HPVA Grade AA, quarter cut, with balance match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 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.
 - 4. Transoms: Continuous match to doors.
- B. Hardboard Facing for Opaque Finish: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides) hardboard, 1/8 inch thick.
- C. Facing Adhesive: Type II - water resistant.

2.05 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.
 - 2. Internally reinforce mineral core doors for hardware attachment without the use of through bolt fasteners.
- C. At exterior doors, provide aluminum flashing at the top and bottom rail.
- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
 - 1. Exception: Doors to be field finished.
- G. Cut and configure exterior door edge to receive recessed weatherstripping devices.
- H. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

- A. 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: Flat.
- 2. Opaque:
 - a. Manufacturers standard, in compliance with performance duty level indicated.
 - b. Color: As selected by Architect.
 - c. Sheen: Gloss.
- B. Factory finish doors in accordance with approved sample.
- C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: As specified in Section 08 11 13.
- B. Metal Louvers: As specified in Section 08 1113.
- C. Glazed Openings: Comply with CBC Section 716.6.3 and Chapter 24.
 - 1. Vision Panel: Factory installed.
 - a. Size (WxH): 6 by 37 inches.
 - 2. G-4 Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 - 3. G-6 Fire-Protection-Rated Glass: Safety Certification, 28 CFR 35, Category II.
 - a. Comply with CBC Section 716.6.
 - 4. Tint: Clear.
- D. Glazing: As specified in Section 08 80 00.
- E. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- F. Door Hardware: As specified in 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 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. Field-Finished Doors: Trimming to fit is acceptable.
 - 1. Adjust width of non-rated doors by cutting equally on both jamb edges.
 - 2. Trim maximum of 3/4 inch off bottom edges.

- 3. Trim fire-rated doors in strict compliance with fire rating limitations.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.
- G. Install door louvers plumb and level.

3.03 TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to 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 access door and frame units.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Openings in partitions.
- B. Section 09 30 00 - Tiling: Tile finishes on and around openings.
- C. Section 09 91 13 - Exterior Painting: Field paint finish.
- D. Section 09 91 23 - Interior Painting: Field paint finish.
- E. Divisions 11, 12, 13, and 14: Miscellaneous components requiring access.
- F. Divisions 21, 22, 23, 26, 27, and 28: Mechanical and Electrical components requiring access.
 - 1. Access doors in ductwork.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
 - 1. If other than specified products by specified manufacturer, submit product data for each type of access door to be used. Include schedule of access door types, sizes and locations.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
 - 1. For access doors other than shown on Drawings, submit marked floor plan giving locations of all access doors. Submit shop drawing for Architect's review before laying out utility services which require access doors.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.
- E. 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.

1.06 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.
- B. Regulation Requirements: 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.
- C. 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 - Building Materials Directory. Provide UL label on each fire-rated access door.
- 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.

1.07 PROJECT CONDITIONS

- A. Verification: Obtain specific locations and sizes for required access doors for Work specified in Plumbing, Mechanical, Electrical or other Sections, for access to concealed equipment, and indicate on submitted schedule.
- B. Special-Size Access Doors: Sizes up to 20-inches by 30-inches used where necessary or as indicated. Indicate special size access doors on submitted schedule.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS

- 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.

2.02 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
 - 1. Location: As indicated on drawings.
 - 2. Material: Steel.
 - 3. Size: 24 inch by 24 inch.
 - 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.

6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- B. Wall-Mounted Units in Wet Areas:
1. Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
 2. Size: 24 inch by 24 inch.
 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
 5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- C. Fire-Rated Wall-Mounted Units:
1. Wall Fire-Rating: As indicated on drawings.
 2. Material: Steel.
 3. Size: 24 inch by 24 inch.
 4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
- D. Ceiling-Mounted Units:
1. Material: Steel.
 2. Size - Other Ceilings: 24 inch by 24 inch.
 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.03 WALL AND CEILING MOUNTED UNITS

- A. Manufacturers:
1. ACUDOR Products Inc: www.acudor.com/#sle.
 2. Babcock-Davis: www.babcockdavis.com.
 3. Cendrex, Inc: www.cendrex.com/#sle.
 4. JL Industries Division of Activar, Inc.: www.activarcpg.com/jl-industries.
 5. Larsen's Manufacturing Co.: www.larsensmfg.com.
 6. Karp Associates, Inc: www.karpinc.com.
 7. Milcor, Inc: www.milcorinc.com.
 8. Nystrom, Inc: www.nystrom.com.
 9. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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: As indicated on drawings.
 2. Door Style: Single thickness with rolled or turned in edges.

3. Frames: 16 gage, 0.0598 inch, minimum thickness.
 - a. Exposed flange: Nominal 1-inch wide around perimeter of frame. Provide flange at flush-mounted (surface) access doors.
 - b. For installation at gypsum drywall or gypsum veneer plaster finishes: Provide perforated frames with drywall bead.
 - c. For installation in concrete or masonry construction: Provide frames with adjustable metal masonry anchors.
 - d. For installation at full-bed plaster finishes: Provide frames with galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
 4. Heavy Duty Frames: 14 gage, 0.0747 inch, minimum thickness.
 5. Heavy Duty Single Steel Sheet Door Panels: 14 gage, 0.0747 inch, minimum thickness.
 6. Double-Skinned Hollow Steel Sheet Door Panels: 16 gage, 0.059 inch, minimum thickness, on both sides and along each edge.
 7. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall face.
 8. Insulation: Non-combustible mineral wool or glass fiber.
- C. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
1. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 2. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 3. Steel Finish: Primed.
 4. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
 5. Door/Panel Size: As indicated on the drawings.
 6. 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: Cylinder lock-operated cam latch, two keys for each unit.
- D. 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.
- E. Provide recess-mounted doors and frames with expanded metal lath for concealed installation in plaster.

2.04 ACCESSORIES

- A. Furnish attachment devices and fasteners of type required to secure access doors to types of support shown.

- B. Locks:
 - 1. Non-Rated Access Doors: By Manufacturer, type where indicated
 - a. Cam-action latch with special square-shanked key.
 - 2. Fire-Rated Access Doors: By Manufacturer, type where indicated.
 - a. Flush key device for self-latching bolt-type latch.
 - 3. Key all locks alike, unless otherwise scheduled.
 - 4. Where shown or scheduled, provide one cylinder lock per access door.
 - 5. For recess-mounted access doors, provide access sleeves for each locking device.
 - 6. Provide plastic grommets for installation in holes cut through finish.

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, in compliance with requirements of listing authority..
- 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 42 29
AUTOMATIC ENTRANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged power-operated door assemblies of following types:
 - 1. Sliding type.
- B. Controllers, actuators and safety devices.
- C. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 28 10 00 - Access Control: Connection to access control system; access control devices used as actuators.
- B. Section 28 46 20 - Fire Alarm: Connection to fire alarm system.

1.03 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. 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).
- C. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; 2011.
- D. BHMA A156.19 - American National Standard for Power Assist and Low Energy Power Operated Doors; 2013.
- E. ITS (DIR) - Directory of Listed Products; current edition.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 101 - Life Safety Code; 2015.
- H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
 - 2. Wiring Diagrams: For power, signal, and activation / safety device wiring.

3. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.
- C. Product Data: Provide data on system components, sizes, features, and finishes.
- D. Samples: Submit two samples of exposed to view hardware, and attachment hardware.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Maintenance Contract.
- I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- J. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.
- K. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.
- L. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.
 2. Wrenches and other tools required for maintenance of equipment.

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, and a member of AAADM.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
 1. Certified by AAADM.

1.07 REGULATORY REQUIREMENTS

- A. Automatic and power-assisted doors shall comply with CBC Section 11B-404.3.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sliding Automatic Entrance Door Assemblies:
 1. ASSA ABLOY Entrance Solutions; Besam SL500: www.besam-usa.com/#sle.
 2. Horton Automatics: www.hortondoors.com.

3. Stanley Access Technologies; Dura-Glide 3000 Sliding: www.stanleyaccess.com/#sle.
4. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 POWER OPERATED DOORS

- A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
 1. Sliding and Folding Door Operators: In the event of power failure, provide for manual open, close, and break-away operation of door leaves.
 2. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
 - a. Finish exposed equipment components to match door and frame finish.
 3. Air Leakage: Maximum of 1.0 cu ft/min/sq ft of wall area, when tested in accordance with ASTM E283 at 1.57 lbs/sq ft pressure differential across assembly.
 4. Exterior and Vestibule Doors: Provide equipment suitable for operating temperature range of minus 20 to plus 140 degrees F ambient.
- B. Sliding and Folding Doors with Full Power Operators: Comply with BHMA A156.10; safeties required; provide break-away operation unless otherwise indicated; in the event of break-away operation, interrupt power operation.
 1. Comply with UL 325; acceptable evidence of compliance includes UL (DIR) or ITS (DIR) listing or test report by testing agency acceptable to authorities having jurisdiction.
 2. Force Required to Swing Break-Away Panel: 50 pound-force, maximum, measured at 1 inch from the latch edge of the door at any point in the closing cycle.

2.03 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. Comply with ADA Standards for egress requirements.
- B. Framing and Transom Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
 1. Nominal Sizes:
 - a. Single Slide and Bi-Parting Sliding Doors: 1-3/4 inch wide by 4-1/2 inch deep.
 - b. Telescoping Sliding Doors: 1-3/4 inch wide by 6 inch deep.
 2. Concealed Fastening: Provide concealed fastening pocket in framing, with continuous flush insert cover extending full length of each framing member.
 3. Transoms: Provide flush glazed transom with framing that is integral with automatic entrance framing system.
- C. Door and Sidelight Construction: Heavy duty interlocked extruded aluminum tubular stile and rail sections, through-rod bolted construction with steel corner support at hinge stile of carrier-suspended swinging panels or mechanically fastened corners with welded reinforcing brackets to reduce sag in sliding or breakout mode.
 1. Door Thickness: 1-3/4 inch, nominal.
 2. Stile Design:
 - a. Narrow stile, 2 inch, nominal width.

3. Top Rail Height: 4 inch, nominal.
 4. Center Rail (Muntin Bar) Height: 2 inch, nominal.
 5. Bottom Rail Height: 4 inch, nominal.
 6. Glazing Stops: Manufacturer's standard snap-on extruded aluminum square stops with preformed resilient glazing gaskets.
 7. Glazing Stop Width: Manufacturers standard.
 8. Glazing Thickness: 1/4 inch.
- D. Sliding Automatic Door: Single leaf track-mounted, electric operation, extruded aluminum glazed door, with frame, and operator concealed overhead.
1. Operation: Power open, power boost operation.
 2. Exterior-Side Actuator/Safety: Motion sensor.
 3. Interior-Side Actuator/Safety: Motion sensor.
 4. Hold Open: Toggle switch at inside head of doors; this is not a fire-rated door.
 5. Door and Frame Finish: Same as adjacent framing system.

2.04 CONTROLLERS, ACTUATORS, AND SAFETIES

- A. Controller: Provide microprocessor operated controller for each door.
- B. Comply with BHMA A156.10 for actuator and safety types and zones.
- C. Proximity Detector Actuator/Safety: Passive infrared; distance of control sensitivity adjustable.

2.05 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
 1. 1/4 hp.
 2. 4 rated load amperes.
 3. 120 volts, single phase, 60 Hz.
- B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- C. Disconnect Switch: Factory mount disconnect switch in control panel.

2.06 ACCESSORIES

- A. Steel Clips, Supports, and Steel Anchors: Galvanized to 1.25 oz/sq ft.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available and is of the correct characteristics.

3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.
- C. Provide for dimensional distortion of components during operation.
- D. Coordinate installation of components with related and adjacent work; level and plumb.

3.03 FIELD QUALITY CONTROL

- A. Manufacturers Field Services:
 - 1. Manufacturer's representative shall provide technical assistance and guidance for installation of doors.
 - 2. Before placing doors into operation, AAADM certified technician shall inspect and approve doors for compliance with BHMA A156.19. Certified technician shall be approved by manufacturer.

3.04 ADJUSTING

- A. Adjust door equipment for correct function and smooth operation.
- B. Adjust doors in compliance with BHMA A156.19.

3.05 CLEANING

- A. Remove temporary protection, clean exposed surfaces.

3.06 CLOSEOUT ACTIVITIES

- A. Engage a factory-authorized representative to train District's maintenance personnel to adjust, operate, and maintain safe operation of the door.
- B. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.07 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 one year from Date of Substantial Completion, at no extra charge to District.
 - 1. During the warranty period a factory-trained technician shall perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the District.
 - 2. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal business hours.
 - 3. Manufacturer shall have in place a dispatch procedure that shall be available 24 hours a Day, 7 Days a week for emergency call back service.

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.
- E. 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 07 25 00 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- E. Section 08 42 29 - Automatic Entrances.
- F. Section 08 44 13 - Glazed Aluminum Curtain Walls.
- G. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- H. Section 08 80 00 - Glazing: Glass and glazing accessories.
- I. Section 12 24 00 - Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

- A. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. ACI 304R - U.S. Postal Service Standard 4C; effective date September 3, 2006.
- D. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
 - 1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
 - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
 - 1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- J. 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).
- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
 - 1. Use 2002 as indicated in 2016CBC Referenced Standards.
- L. 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.
- M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

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 33 00 - Submittal Procedures, 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, internal drainage details.
 - 1. Include construction details and fabrication methods, profiles and dimensions of individual components, data on hardware, accessories, and finishes.
 - 2. 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.
- 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. Complete, indicating elevation views of all units, attachments to surrounding construction of Project, type of glazing, and all door hardware and weatherstripping. All Shop Drawings shall be prepared by manufacturer and shall include manufacturer's logo.
- E. Samples: Submit two samples 2 x 3 inches in size illustrating finished aluminum surface, glass, glazing materials.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- 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. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- J. Manufacturer's Qualification Statement.
- K. Installer's Qualification Statement.
- L. Warranty: Submit manufacturer warranty and ensure forms have been completed in District's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with Code requirements for safety glazing, accessibility and exit devices.
 1. Conform to applicable requirements of the Americans with Disabilities Act Accessibility Guidelines 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 shall match locksets.
 4. Conform to applicable requirements of Title 24, Part 2, CCR, including Sections 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. The maximum effort to operate fire doors may be increased to the maximum allowable by the appropriate administrative authority, but in no case shall the pressure exceed 15 pounds. CBC 11B-404.2.9.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.
- D. Single-Source Responsibility: All entrances and storefront framing and doors, including finish, shall be the product of one manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AASHTO M 252.

- 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.

1.08 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.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. All doors shall carry manufacturer's lifetime warranty on door corner construction, provided in writing.
- C. Correct defective Work within a five year period after Date of Substantial Completion.
- D. 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.
- E. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Front-Set Style, Thermally-Broken:
 - 1. Basis of Design: Arcadia Corp; Offset Glazed System TC470 Series - Thermal - Shear Block Inside Set: www.arcadiainc.com.
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

- A. Center-Set Style: (Interior)
 - 1. Basis of Design: Arcadia Corp; Center Glazed System A400 Series - Non-Them - Shear Block Inside Set: www.arcadiainc.com.
 - 2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep.
- B. Front-Set Style:
 - 1. Basis of Design: Arcadia Corp; Offset Glazed System AF450Series, Shear Block Inside Set: www.arcadiainc.com.
 - 2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep.

2.03 BASIS OF DESIGN -- SWINGING DOORS

- A. Wide Stile, Insulating Glazing, Not Thermally-Broken:

1. Basis of Design: Arcadia Corp; WS512HD Series Heavy Duty Wide Stile:
www.arcadiainc.com.

2.04 ACCEPTABLE MANUFACTURERS

- A. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another manufacturer
- B. Aluminum-Framed Storefront and Doors:
 1. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 - a. For any product not identified as "Basis of Design", submit information as specified for substitutions.
 - b. Substitution may or may not be accepted after Architect and District review with complete evaluation for content and schedule impact.
 - c. Substitutions shall include all costs for redesign with consequential changes by other trades along with the Architect and related approvals by governing agencies.
 - 1) Revision to shop drawings illustrating changes is not considered adequate for DSA review and approval.
 - 2) A minimum fee of \$10,000.00 for DSA review processing by the Architect will need to be included for additional DSA review of any substituted system other than the basis of design.
 - 3) An additional minimum allowance of \$10,000.00 is required for Architect's time to review the substituted system prior to submitting for governing agency approval.
 - 4) The indicated fee amounts are minimums. These are subject to increase pending Architect and DSA reviews of the proposed substitution.
 - d. Substitutions may be acceptable, based on Architect's review and approval, for submittal to DSA.
 - 1) If substituted manufacturer cannot reproduce design and DSA approval in a timely manner, then they shall be subject to a time and material back charge for any delays in the project.
 - 2) Architect approval is required prior to DSA submittal and DSA approval is required prior to installation.

2.05 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. Finish: Superior performing organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 3. Finish Color: As selected by Architect from manufacturer's standard line.

4. 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.
5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. 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.
7. 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.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
11. 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: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 12 psf.
3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
4. Energy Performance:
 - a. NFRC Values:

1) U-Value:	0.41.
2) Solar Heat Gain Coefficient:	0.34.
3) Visible Transmittance:	0.61.
 - b. The District has used NFRC certified values for the analysis of this building. It does not allow for the use of CCR Title 24 default values.
 - c. Provide products that meet or exceed the U-factor and S.H.G.C. values listed on the ENV-1 form, filed in the contract documents elsewhere.
 - d. AAMA ratings are not allowed under CCR Title 24 and will not be acceptable.

5. Resistance to Forcible Entry: Jambs adjacent to door locks shall resist a force of 1600 pounds.

2.06 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: As specified in Section 08 80 00.
 1. For Exterior Framing: Type as indicated on Drawings.
 2. For Interior Framing: Type as indicated on Drawings.
- C. Swing Doors: Glazed aluminum.
 1. Thickness: 1-3/4 inches.
 2. Top Rail: 5-1/8 inches wide, nominal.
 3. Vertical Stiles: 5 inches wide, nominal. Coordinate with hardware for a complete installation.
 4. Bottom Rail: 10 inches high, minimum.
 5. Glazing Stops: Beveled.
 6. Finish: Same as storefront.
- D. Horizontal Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 1. Configuration: As indicated on drawings.
 2. Sun Screen Angle: 0 degrees from horizontal.
 3. Outrigger Shape: As indicated on Drawings.
 4. Design Criteria: Design and fabricate to resist the same loads as storefront system as well as the following loads without failure, damage, or permanent deflection:
 - a. Snow: 0 psf; minimum.
 - b. Live: 20 psf; minimum.
 - c. Thermal Movement: Plus/minus 1/8 inch, maximum.
 5. Sizes: As indicated on drawings.
 6. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
- E. Vertical Sun Shades: Shop fabricated, shop finished, extruded aluminum outriggers, and fascia, free of defects impairing strength, durability or appearance.
 1. Configuration: As indicated on drawings.
 2. Louver Type: Airfoil.
 3. Sun Screen Angle: 90 degrees from horizontal.
 4. Outrigger Shape: As indicated on Drawings.

5. Design Criteria: Design and fabricate to resist the same loads as storefront system as well as the following loads without failure, damage, or permanent deflection:
 - a. Snow: 0 psf; minimum.
 - b. Live: 0 psf; minimum.
 - c. Thermal Movement: Plus/minus 1/8 inch, maximum.
6. Sizes: As indicated on drawings.
7. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
8. Provide graphic film per section

2.07 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; shop primed.
- D. Structural Supporting Anchors: See Section 05 12 00.
- E. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- F. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.
- G. Fasteners: Stainless steel.
- H. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- I. Concealed Flashings: Galvanized steel, 26 gage, 0.0179 inch minimum base metal thickness.
- J. Sealant for Setting Thresholds: Non-curing butyl type.
- K. Perimeter Sealant: Type as specified in Section 07 92 00 - Joint Sealants.
- L. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
 1. All storefront systems shall include "top-load" glazing gaskets.
- M. Glazing Accessories: As specified in Section 08 80 00.
- N. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- O. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.08 FINISHES

- A. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride (PVDF) system.
 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as indicated on drawings.
 - a. Manufacturers:
 - 1) PPG Metal Coatings; Duranar: www.ppgmetalcoatings.com/#sle.
 - 2) Sherwin-Williams Company; SHER-NAR 5000: oem.sherwin-williams.com/#sle.
 - 3) Valspar; Fluropon: www.valsparcoilextrusion.com/#sle.

- 4) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.09 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Door Hardware for Aluminum Entrances and Storefronts:
 - 1. Install standard door hardware as specified in this Section and custom hardware and door thresholds as specified in Section 08 71 00 - Door Hardware.
 - 2. Hardware shall not require tight gripping, pinching or twisting of the wrist.
 - 3. Mounting heights as indicated on Section 08 71 00 Door Hardware.
- C. Hardware Finish: Plated or metallic finish, BHMA 626 satin chrome, BHMA 627 satin aluminum and BHMA 630 satin stainless steel, as applicable.
- D. Other Door Hardware: As specified in Section 08 71 00.
- E. Weatherstripping: manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D2000 or molded PVC complying with ASTM D2287, continuous and replaceable; provide on all exterior doors.
 - 1. Provide manufacturer's optional bottom rail weathering strip.
 - 2. Retainer finish to match door.
- F. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- G. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.
- H. Automatic Door Operators and Actuators: As specified in Section 08 42 29.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
 - 1. Dimensions: Verify dimensions shown on Drawings and obtain field measurements of actual construction prior to preparing shop drawings and ordering products.
 - 2. Substrate Conditions: Verify that conditions of substrate and adjoining Work are suitable for proper installation of entrance and storefront Work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. 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.

- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. 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.
- H. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- I. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- 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.
 - 2. Set thresholds in bed of sealant and secure.
 - 3. Adjustment: Adjust operating hardware and door operation for smooth movements, without binding and without exceeding allowable forces of accessibility regulations.
- L. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07 92 00 - Joint Sealants.
- 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.

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 45 00 - Quality Control, for general testing and inspection requirements.
- C. Water-Spray Test: 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 indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Testing: Water test all storefront and glazing after completion by spraying with hose heavily for 5 minutes. Repair all leaks discovered by testing procedures and repeat test until leak-free performance is achieved.

4. Provide written report to Architect and IOR.
- D. Provide field testing of installed storefront system by 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.
 4. Provide written report to Architect and IOR.
- E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance conforms to 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.
 1. Flush thoroughly and wipe surfaces clean.
 2. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess sealant by method acceptable to sealant manufacturer.
- E. Glass Cleaning: See Section 08 80 00 - Glazing.

END OF SECTION

SECTION 08 44 13
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.
- B. Perimeter sealant.
- C. Firestopping between curtain wall and edge of floor slab.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Weld plates embedded in concrete for attachment of anchors.
- B. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
- C. Section 05 50 00 - Metal Fabrications: Steel attachment devices.
- D. Section 07 84 00 - Firestopping: Firestop at system junction with structure.
- E. Section 08 43 13 - Aluminum-Framed Storefronts: Entrance framing and doors.
- F. Section 08 80 00 - Glazing.
- G. Section 09 21 16 - Gypsum Board Assemblies: Metal stud and gypsum board wall at interior of curtain wall.
- H. Section 12 24 00 - Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

- A. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. AAMA CW-DG-1 - Aluminum Curtain Wall Design Guide Manual; 1996 (R2005).
- D. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
 - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
 - 1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

- J. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015a.
- K. 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).
- L. 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.
- M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting three weeks before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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.
- C. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, special installation requirements, and infill.
 - 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.
- D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, expansion and contraction joint location and details, and field welding required.
- E. Samples: Submit two samples 4 by 4 inches in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- G. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.

- H. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- I. Report of field testing for water leakage after installation.
- J. Installer's Qualification Statement.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in District's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with Code requirements for safety glazing, accessibility and exit devices.
 - 1. Exit Doors: Openable at all times from the inside without the use of a key or any special knowledge or effort.
 - 2. Exit devices shall comply with CBC Section 1008.1.9. Lever handle trim shall match locksets.
 - 3. Conform to applicable requirements of the Americans with Disabilities Act Accessibility Guidelines regarding accessibility requirements for door and entrance hardware.
 - 4. Conform to applicable requirements of Title 24, Part 2, CCR, including Sections 11B-404.2.7 Door and Gate Hardware, 11B-404.2.9 Door and Gate Opening Force, and 1008.1.9 Door Operation, 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. The maximum effort to operate fire doors may be increased to the maximum allowable by the appropriate administrative authority, but in no case shall the pressure exceed 15 pounds.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 MOCK-UP

- A. See Section 01 45 00 - Quality Control, for general requirements for mock-ups.
- B. Provide 8 by 8 feet mock-up including each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
- C. Locate on-site where directed by Architect; mock-up may remain as part of the Work.
- D. Locate off-site where directed, and remove when directed.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AASHTO M 252.
- 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 curtain wall 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 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.10 SEQUENCING AND SCHEDULING

- A. Scheduling installation of the glazed aluminum curtain wall system in sequence with related elements of the work specified in other Sections to endure that wall assemblies, including flashing, trim, and joint sealers, are protected against damage from effects of weather, age, corrosion, and other causes.

1.11 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.

1.12 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, 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. All doors shall carry manufacturer's lifetime warranty on door corner construction, provided in writing.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Pressure Cap Four Sides; Not Unitized, Field Assembled:
 1. Basis of Design: Arcadia, Inc.; T-500 Series, OPG-3000 and T-500 Series, OPG-6000, 2-1/4 inch wide face: www.arcadiainc.com.
- B. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.
 2. Substitution may or may not be accepted after Architect and District review with complete evaluation for content and schedule impact.

3. Substitutions shall include all costs for redesign with consequential changes by other Contractor trades along with the Architect and related approvals by governing agencies.
 - a. Revision to shop drawings illustrating changes is not considered adequate for DSA review and approval.
 - b. A minimum fee of \$10,000.00 for DSA review processing by the Architect will need to be included for additional DSA review of any substituted system other than the basis of design.
 - c. An additional minimum allowance of \$10,000.00 is required for Architect's time to review the substituted system prior to submitting for governing agency approval.
 - d. The indicated fee amounts are minimums. These are subject to increase pending Architect and DSA reviews of the proposed substitution.
4. Substitutions may be acceptable, based on Architect's review and approval, for submittal to DSA.
 - a. If substituted manufacturer cannot reproduce design and DSA approval in a timely manner, then they shall be subject to a time and material back charge for any delays in the project.
 - b. Architect approval is required prior to DSA submittal and DSA approval is required prior to installation.

2.02 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Fabrication Method: Field fabricated stick system.
 2. Glazing Method: Field glazed system.
 3. Finish: High performance organic coatings.
 - a. Factory finish surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 4. Provide flush joints and corners, weather-sealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. 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.
 7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.
 8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

9. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 1. Design Wind Loads: Comply with the requirements of ASCE 7.
 - a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (over 11'-0" span), whichever is less and with full recovery of glazing materials.
 - b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
 2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
 3. Interstory Differential Lateral Movement: Meeting pass/fail criteria of ASCE 7 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
 4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
 1. Test Pressure Differential: 10 psf.
 2. Test Method: AATCC Test Method 134.
- D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
- E. Thermal Performance Requirements:
 1. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.

2.03 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. Cross-Section: As indicated on drawings.
 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 4. Aluminum tubes for Sun Control Support: Provide and install additional integrated aluminum tube sections for support of sun control brackets and their associated loads.

- B. Glazing: As specified in Section 08 80 00.
- C. Aluminum Entrance Doors and Hardware
 - 1. See Section 08 43 13 for doors and hardware.
- D. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 - 1. Sun Screen Configuration: As indicated on drawings.
 - 2. Louver Type: Vertical trim cap, depth and shape as indicated on Drawings.
 - 3. Sun Screen Angle: 90 degrees from horizontal.
 - 4. Outrigger Shape: Straight.
 - 5. Design Criteria: Design and fabricate to resist the same loads as curtain wall system as well as the following loads without failure, damage, or permanent deflection:
 - a. Thermal Movement: Plus/minus 1/8 inch, maximum.
 - 6. Sizes: As indicated on drawings.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; shop primed.
- D. Structural Supporting Anchors: See Section 05 12 00.
- E. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- F. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
- G. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- H. Concealed Flashings: Sheet aluminum, 26 gage, 0.017 inch minimum thickness.
- I. Firestopping: As specified in Section 07 84 00.
- J. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
- K. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.
- L. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
 - 1. Manufacturer's standard permanent framing system gaskets and joint fillers, depending on joint movement and sealing requirements, such as sliding joints, compression joint translation, or non-moving joints. Inside glazing face to receive closed cell neoprene sponge gaskets (ASTM C509). Exterior glazing seal gasket shall be fixed resilient elastomeric EPDM glazing spline.
- M. Glazing Accessories: As specified in Section 08 80 00.
- N. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- O. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 FINISHES

- A. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.
 - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as indicated on drawings.
 - a. Manufacturers:
 - 1) PPG Metal Coatings; Duranar: www.ppgmetalcoatings.com/#sle.
 - 2) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Color: As indicated on drawings.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce interior horizontal head rail to receive blind brackets and attachments.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other related work.
- B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

- A. Install curtain wall system in accordance with manufacturer's instructions and AAMA CW-DG-1.
- 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 at all sill conditions. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- H. Install firestopping at each floor slab edge.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Internal wiring:
 - 1. Wiring routed through mullions shall be by installer with immediate oversight by related smoke control, fire alarm system, and low-voltage system SubContractors. Connections shall be load tested with the correct devices at each appropriate stage of sub-assembly to prior to and after final assembly.
 - 2. Failed wiring connections shall be replaced at no additional cost to District.
- K. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 08 80 00, using exterior dry glazing method.
- L. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.
- M. 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 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.
 - 1. Curtain wall manufacturer shall provide field surveillance of the installation of their products.
 - 2. Inspect, monitor and report installation procedures and unacceptable conditions to Architect and Construction Manager.
- B. See Section 01 45 00 - Quality Control, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- C. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AATCC Test Method 16 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 10 percent and 50 percent completion of this work.
 3. Testing: Water test all storefront and glazing after completion by spraying with hose heavily for 5 minutes. Repair all leaks discovered by testing procedures and repeat test until leak-free performance is achieved.
 4. Provide written report to Architect and IOR.
- D. Provide field testing of installed curtain wall system by 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.
 4. Provide written report to Architect and IOR.
- E. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.05 ADJUSTING

- A. Adjust operating 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, take care to remove dirt from corners, and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess sealant by method acceptable to sealant manufacturer.
- E. Glass Cleaning: See Section 08 80 00 - Glazing.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 62 23
TUBULAR SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly.

1.02 RELATED REQUIREMENTS

- A. Division 7 - Roofing: Flashing-in of skylight base.
- B. Division 26 - Electrical: Electrical connections, lighting equipment and controls and lenses..

1.03 REFERENCE STANDARDS

- A. AASHTO HB - Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail; 2012.
- B. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process; 2015.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- F. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
- G. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2016.
- H. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics; 2016.
- I. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2011.
- J. 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).
- K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- L. ICC ES AC16 - Acceptance Criteria for Plastic Skylights; 2002.
- M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- N. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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.
 4. ICC-ES evaluation report.
- C. Shop Drawings: Show layout, profiles and product components, including anchorage, flashings and accessories.
- D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
1. Evidence of AAMA Certification.
 2. Evidence of WDMA Certification.
 3. Evidence of CSA Certification.
 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- E. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

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 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Skylights: Manufacturer's standard warranty for 10 years.
- C. Electrical Parts: Manufacturer's standard warranty for 5 years, unless otherwise indicated as longer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. DayLite, Natural Lighting Technologies: www.dayliteco.com.
- B. Solatube International, Inc; SolaMaster, Closed Ceiling with PrisMatic diffuser and Daylight Dimmer: www.solatube.com/sle.
- C. Sunoptics Prismatic Skylights, a Division of Acuity Brands; LightFlex Tubular Daylighting System - SLFT: www.sunoptics.com/#sle.
- D. Tubular Skylight Inc: www.tubular-skylight.com.
- E. Velux America, Inc; VELUX TCC - Curb Mounted SUN TUNNEL Skylight: www.veluxusa.com/#sle.
- F. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 TUBULAR SKYLIGHTS

- A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces.
 - 1. Fabrication and assembly of components is by single manufacturer.
 - 2. Non-Metal Parts: Flammability less than the following.
 - a. Roof-Top Components: Class B when tested in accordance with ASTM E108 or UL 790.
 - b. Self-Ignition Temperature: Greater than 650 degrees F, when tested in accordance with ASTM D1929.
 - c. Smoke Developed Index: Maximum of 450, when tested in accordance with ASTM E84; or maximum rating of 75, when tested in accordance with ASTM D2843.
 - d. Combustibility - Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.
 - e. Combustibility - Non-Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.
 - 3. Thermal Movement: Fabricate to allow for thermal movement resulting from temperature differential from minus 30 to 180 degrees F without damage to components, fasteners, or substrates.
- B. Roof Assemblies: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - 1. Glazing: Acrylic plastic, 1/8 inch minimum thickness.
 - 2. Low-Angled Sun Reflector: Light intercepting transfer device, made of same material as main tube, to capture low angle sunlight.
 - 3. Low-Slope Roof Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube; size and type where indicated.
 - 4. Base Material: Sheet steel, galvanized, ASTM A653/A653M, 24 gage, 0.0239 inch thick, minimum.
 - 5. Base Height: .

- a. Type F11, Self mounted, 11 inches (279 mm) high.
- 6. Base Pitch (Slope): As indicated on Drawings..
- 7. Dome Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact ABS; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing; weather seal of medium density pile weather stripping.
- C. Reflective Tube: ASTM B209 (ASTM B209M) aluminum sheet, thickness between 0.015 inch and 0.020 inch.
 - 1. Interior Finish: Exposed interior surfaces of high reflectance specular finish; specular reflectance 99, total solar spectrum reflectance less than 93 percent.
 - 2. Tube Diameter: 14 inches.
 - 3. Tube Configuration and Length: As indicated on the drawings.
- D. Diffuser Assemblies: Supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration.
 - 1. Ceiling Ring: Edge trim for ceiling opening; Round to square transition box made of opaque polymeric material, classified as CC2, Class C, 0.110 inch (2.8 mm) thick.
 - 2. Diffuser Trim: Edge and attachment trim for diffuser lens; injection molded high impact ABS.
 - 3. Diffuser Shape in Lay-In Ceiling Grid: Square, 24 by 24 inches, to fit grid; metal transition box.
 - 4. Lens: Prismatic lens design to maximize light output and diffusion.
 - 5. Lens Material: Acrylic plastic.
 - 6. Lens Thickness: 0.038 inch, minimum.
 - 7. Visible Light Transmission (VLT): 90 percent, minimum.
 - 8. Seal: Closed cell EPDM foam rubber.

2.03 PERFORMANCE REQUIREMENTS

- A. Grade: AASHTO HB requirements for specific tubular skylight:
 - 1. Product Type: Tubular Daylighting Device, Closed Ceiling (TDDCC).
 - 2. Performance Grade (PG): 35, with minimum design pressure (DP) of 35.09 psf.
- B. No permanent deflection in excess of 0.2 percent of span.
- C. Air Infiltration: Maximum 0.10 cu ft/min sq ft per unit area of outside frame dimension at 6.27 psf pressure differential when tested in accordance with ASTM E283.
- D. Water Resistance: No uncontrolled water leakage at 6.27 psf pressure differential with water rate of 5 gallons/h/sf, when tested in accordance with ASTM E331; design to ensure that water will not accumulate inside assembly.

2.04 DIMMER

- A. Local Dimmer Control: Provided with dimmer switch and cable.
 - 1. Daylight Dimmer: Type D Electro-mechanically actuated daylight valve; for universal input voltages ranging between 90 and 277 V at 50 or 60 Hz; maximum current draw of

50 ma per unit; controlled by low voltage, series Type T02: circuited, 4 conductor, size 22 cable; providing daylight output between 2 and 100 percent. Provided with dimmer switch and cable.

2. Switch: Type SW, Manufacturer-specific low voltage DC DP/DT switch (white) required to operate Daylight Dimmer. Note: only one switch is required per set of synchronously controlled dimmers.
3. Cable: Type CA, Two conductor low voltage cable (500 ft.) for multiple unit DC connection.

2.05 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
 1. Security Kit: Type SK Dome Security Kit, rivets with nylon spacers to replace dome screws.
- B. Wire Suspension Kit: Type E, Use the wire suspension kit when additional bracing to the structure is required.
- C. Sealant: Elastomeric, silicone or polyurethane; compatible with materials being sealed.

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 the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Set roof assembly flashing in continuous bead of sealant.
- C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.
- D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

3.04 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 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Lock cylinders for doors that hardware is specified in other sections.
- E. Thresholds.
- F. Weatherstripping and gasketing.

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 00 - Signage: Additional signage requirements.
- H. Section 28 10 00 - Access Control: Electronic access control devices.
- I. Section 28 46 20 - Fire Alarm: Electrical connection to activate door closers.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. BHMA (CPD) - Certified Products Directory; 2016.
- C. BHMA A156.1 - American National Standard for Butts and Hinges; 2013.
- D. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- E. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
- F. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
- G. BHMA A156.6 - American National Standard for Architectural Door Trim; 2010.
- H. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2014.
- I. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2010.
- J. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2012.
- K. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2011.
- L. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2013.

- M. BHMA A156.17 - American National Standard for Self Closing Hinges & Pivots; 2014.
- N. BHMA A156.20 - American National Standard for Strap and Tee Hinges, and Hasps; 2006 (Reaffirmed 2012).
- O. BHMA A156.21 - American National Standard for Thresholds; 2014.
- P. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012.
- Q. BHMA A156.25 - American National Standard for Electrified Locking Devices; 2013.
- R. BHMA A156.26 - American National Standard for Continuous Hinges; 2012.
- S. BHMA A156.28 - American National Standard for Recommended Practices for Mechanical Keying Systems; 2013.
- T. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.
- U. BHMA A156.36 - American National Standard for Auxiliary Locks; 2014.
- V. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- W. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- X. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.
- Y. DHI (KSN) - Keying Systems and Nomenclature; 1989.
- 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.
- AB. ITS (DIR) - Directory of Listed Products; current edition.
- AC. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- AD. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- AE. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- AF. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- AG. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- AH. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- AI. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

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.
 - 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 33 00 - Submittal Procedures, for submittal procedures.
- B. 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.

- C. 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, refer to Section 08 06 71.
 3. List groups and suffixes in proper sequence.
 4. Provide complete description for each door listed.
 5. Provide manufacturer's and 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.
- D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
 2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
 3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
- 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. 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.
- J. Manufacturers' certificates that fire-rated hardware meets or exceeds specified requirements.
- K. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in District's name and registered with manufacturer.
- L. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- M. Maintenance Materials and Tools: Furnish the following for District's use in maintenance of project.
1. See Section 01 63 00 - Product Substitution Procedures, 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. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
1. Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
 3. Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

1.07 REGULATORY REQUIREMENTS

- A. Fire-Rated Openings: Comply with NFPA 80. Provide only hardware tested and listed by UL for the type and size of each door required, which complies with the requirements of the door and frame labels. California State Fire Marshal Standard 12-7-4
 - 1. Where exit devices are required on fire rated doors, provide supplementary marking on door UL label indicating "Fire Door to be Equipped with Fire Exit Hardware", and provide UL label on exit device indicating "Fire Exit Hardware".
 - 2. Comply with State Fire Marshal Standard 12-10-3 Exits, Section 12-10-302.
 - a. The cross-bar shall extend across not less than one-half the width of the door/gate.
 - b. The ends of the cross-bar shall be curved, guarded or otherwise designed to prevent catching on the clothing of persons during egress.
- B. Conform to applicable requirements of the Americans with Disabilities Act Accessibility Guidelines regarding accessibility requirements for door and entrance hardware including gates.
 - 1. Doors/doorways as part of an accessible route shall comply with CBC Sections 11B-404.
 - 2. Doors shall meet California Building Code Sections 11B-206.5, 11b-404.1 and 1010.1.
 - 3. The clear opening width for a door shall be 32 inches minimum. CBC Section 11B-404.2.3
 - a. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees.
 - b. 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.
 - c. Door closers and stops shall be permitted to be 78 inches minimum above the finish floor or ground.
 - d. 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.
 - 4. 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.
 - a. Operable parts of such hardware shall be 34 inches minimum and 44 inches maximum above finish floor or ground.
 - b. 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
 - 5. The force for pushing or pulling open a door shall be as follows : CBC Section 11B-404.2.9.
 - a. Interior Hinged Doors, sliding or folding doors, and exterior hinged doors: 5 lbs maximum.
 - b. Required Fire Doors: the maximum opening force allowable by the DSA authority, not to exceed 15 lbs..

- c. 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.
 - d. 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.
6. Door closing speed shall be as follows: CBC Section 11B-404.2.8
 - a. 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.
 - b. 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.
 7. Thresholds shall comply with CBC Section 11B-404.2.5.
 8. Floor stops shall not be located in the path of travel and 4 inches maximum from walls.
 9. 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
 10. Exit device touchpad shall be compliant with State Fire Marshal Standard 12-10-300, Section 12-10-302.
- C. 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.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.
- B. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- C. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- D. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.09 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 templates and 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. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items.
 - 1) Fire/life-safety system interfacing.
 - 2) Point-to-point wiring diagrams plus riser diagrams to related trades.
 - 3) Access Controls.
 - e. Coordinate: Flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
 - f. 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.

1.10 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
 1. Standard Warranty Period: One year.
 2. Special Warranty Periods:
 - a. Five years for exit hardware.
 - b. Twenty five years for manual surface door closer bodies.
 - c. Five years for motorized electric latch retraction exit devices.
 - d. Two years for electromechanical door hardware.
 3. Locksets and Cylinders: Three years, minimum.
 - a. Seven years for extra heavy-duty cylindrical lock.

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. Provide door hardware products that comply with the following requirements:
 1. Applicable provisions of federal, state, and local codes.
 2. Comply with SB 211 (DSA Bulletin 11-05); CBC section 1010.1.11.
 3. Accessibility: ADA Standards and CBC Chapter 11B.
 4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
 - a. Latching hardware, door closers, ball bearing hinges, and seals are required whether listed in the Hardware Schedule or not.
 6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
 - a. Air Leakage Rate: Tested in accordance with UL 1784, with air leakage rate not to exceed 3.0 cfm/sf of door opening at 0.10 inch of water for both ambient and elevated temperature tests.
 7. Listed and certified compliant with specified standards by BHMA (CPD).
 8. Auxiliary Hardware: BHMA A156.16.
 9. Straps and Tee Hinges: BHMA A156.20.
 10. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
 11. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
 12. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
1. Refer to Section 28 10 00 for additional access control system requirements.
- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Section 08 06 71 for listing of hardware sets.
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. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
7. 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. Manufacturers:
 1. Basis of Design: McKinney (MK).
 2. McKinney; an Assa Abloy Group company: www.assaabloydss.com.
 3. Markar Products; an Assa Abloy Group company: www.assaabloydss.com.
 4. Pemko Products; an Assa Abloy Group company: www.assaabloydss.com.
 5. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. 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.
 - e. Hinge Size: Provide hinge widths sized for door thickness and clearances required:
 - 1) Widths up to 3'-0": 4-1/2" standard or heavy weight as specified.
 - 2) Sizes from 3'-1" to 4'-0": 5" standard or heavy weight as specified.
 3. Continuous Hinges: Comply with BHMA A156.26.
 - a. Pinned steel/stainless steel type: continuous stainless steel, 0.25-inch diameter stainless-steel hinge pin.
 - 1) Use engineered application-specific wide-throw units as needed to provide maximum swing degree of swing, advise Architect if required width exceeds 8 inches.
 4. Provide hinges on every swinging door.
 5. Hinge Weight and Base Material:

- a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless otherwise indicated.
- b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless otherwise indicated.
- 6. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
- 7. Provide ball-bearing hinges at each door with closer.
- 8. Provide non-removable pins on all lockable 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.
- 9. Provide non-removable pins on interior outswinging doors at locations as indicated in Door Hardware Schedule.
- 10. Provide power transfer hinges where electrified hardware is mounted in door leaf.
- 11. 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 POWER TRANSFER DEVICES

- A. Manufacturers:
 - 1. Pemko (PE); an Assa Abloy Group company; EL-CEPT Series: www.assaabloydss.com.
 - 2. Securitron (SU); an Assa Abloy Group company; EL-CEPT Series: www.assaabloydss.com.
 - 3. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware.
- C. Provide McKinney MG-16 mortar guard for each electric hinge specified.
- D. Connectors and Wires:
 - 1. ElectroLynx™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies.
- E. Wire nut connections are not acceptable.

2.04 EXIT DEVICES

- A. Conventional Push Rail Exit Device (Heavy Duty) Manufacturers:
 - 1. Corbin Russwin (RU); an Assa Abloy Group company; ED5000 Series: www.assaabloydss.com.
 - 2. Substitutions: Not permitted.
- B. Exit Devices: Comply with BHMA A156.3, Grade 1.
 - 1. Lever design to match lockset trim.

2. Provide cylinder with cylinder dogging or locking trim.
 3. Provide exit devices properly sized for door width and height.
 4. Provide strike as recommended by manufacturer for application indicated.
 5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
 6. Provide NFPA 80 and UL (DIR) compliant exit device assemblies for fire-rated doors.
 7. For electrical options, provide quick connect plug-in pre-wired connectors.
- C. General features:
1. Push-through push-pad design.
 - a. No exposed push-pad fasteners, no exposed cavities when operated.
 - b. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
 - c. Furnish stainless steel or brass touch pad cover on all exit devices.
 2. Releasable in normal operation with 5-lb. maximum operating force per California State CBC Chapter 11B-309.4
 3. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate.
 4. End caps: Impact-resistant, flush-mounted.
 - a. No raised edges or lips to catch carts or other equipment.
 - b. Cast or forged material and is not to overlap the mechanism case.
 5. Where devices span over door lite frame and the face of the selected lite manufacturer's frame is raised from the face of the door, furnish panic hardware manufacturer's fitted shims or glass-bead kits at no additional cost to the project.
 - a. No exposed rivets or screws on back of device that would be visible through a glass lite.
 6. Comply with CBC Section 1010.1.9.
 7. All mounting fasteners to be concealed. Devices to be non-handed or field reversible.
 8. Furnish stainless steel latchbolt with 3/4 inch throw and security dead-latching for all rim exit devices.
 9. Doors wider than 36 inch provide long bar exit devices.
 10. Doors taller than 7 ft. supply extension rods for required series.
 11. Protect lever trim by a shear pin, which will withstand a rotational force of 35 ft.-lbs before shearing.
 - a. Where a heavy duty, vandal resistant trim is specified, conform to BHMA A156.3 Grade 1 Security Trim standard.
 - 1) Vandal resistance lever to operate in both directions.
 - 2) Protect lever trim by a shear pin, which will withstand a rotational force of 70 ft.-lbs before shearing.
 - 3) The lever is not to separate from the escutcheon.
 12. Trim to meet BHMA A156.3 Trim Security Test.

- D. Tube Steel Removable Mullions: BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.
 - 1. Provide keyed removable feature where specified in the Hardware Sets.
 - 2. Provide stabilizers and mounting brackets as required.
 - 3. Provide electrical quick connection wiring options as specified in the hardware sets.

2.05 ELECTRIC STRIKES

- A. Manufacturers:
 - 1. HES; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Substitutions: Not permitted.
- B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
 - 1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
 - 2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.
 - 3. Provide field selectable Fail Safe/Fail Secure modes.
 - 4. Provide transformer and rectifier as necessary for complete installation.
 - 5. Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

2.06 LOCK CYLINDERS

- A. Manufacturers:
 - 1. Basis of Design: Match facility standard.
 - 2. Substitutions: Not permitted.
- B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
 - 1. Provide standard, electronic, conventional, full size interchangeable core (FSIC), and small format interchangeable core (SFIC) 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.

2.07 MORTISE LOCKS

- A. Manufacturers:
 - 1. Sargent; an Assa Abloy Group company; 8200 Series: www.assaabloydss.com.
 - 2. Substitutions: Not permitted.
- 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. Double-Lipped Strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
 - f. Finish: To match lock or latch.

2.08 ELECTROMECHANICAL LOCKS

- A. Manufacturers:
 1. Sargent; an Assa Abloy Group company; 8200 Series: www.assaabloydss.com/#sle.
 2. Substitutions: Not permitted.
- B. Electromechanical Locks: Comply with BHMA A156.25, Grade 1.
 1. Provide motor-driven or solenoid-driven locks, with strike that is applicable to frame.
 2. Type: Mortise deadbolt.

2.09 AUXILIARY LOCKS (DEADLOCKS)

- A. Manufacturers:
 1. Basis of Design: Facility standard.
- B. 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. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. 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: Aluminum, 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 DOOR PULLS AND PUSH BARS

- A. Door Pulls and Push Bars: Comply with BHMA A156.6.
 1. Bar Type: Bar set, unless otherwise indicated.
 2. Material: Aluminum, unless otherwise indicated.

2.12 CLOSERS

- A. Manufacturers; Surface Mounted:
 1. Norton (RU); an Assa Abloy Group company; 9540 Series: www.assaabloydss.com.
 2. Substitutions: Not permitted.
- B. Manufacturers; Low Energy for ADA Applications:
 1. Basis of Design: SW200i or SL500 manufactured by Besam.
 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Closers: Comply with BHMA A156.4, Grade 1.
 1. Type: Surface mounted to door.
 2. Provide door closer on each exterior door.
 3. Provide door closer on each fire-rated and smoke-rated door.
 - a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
 - b. Comply with UL 10C.
 4. Closers shall have non-ferrous covers, heavy duty forged steel arms, and separate valves for adjusting backcheck, delayed action, closing and latching cycles and adjustable spring to provide sizes 1 through 6.
 5. Provide non-sized closers, adjustable to meet maximum opening force requirements of ADA.
 6. Provide drop plates, brackets, or adapters for arms as required to suit details.
 7. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
 8. At corridor entry doors, mount closer on room side of door.
 9. At outswinging exterior doors, mount closer on interior side of door.

2.13 OVERHEAD STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Rixson (RF); an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Rockwood Products (RO); an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. 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.

2.14 PROTECTION PLATES

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company; K1050: www.assaabloydss.com.
 - 2. Trimco; K0050: www.trimcohardware.com.
 - 3. Substitutions: Not permitted.
- B. Protection Plates: Comply with BHMA A156.6.
- C. Size: Kick plates 10 inches high, Mop plates 6 inches high, Armor plates 36 inches high.
- D. Width: 2 inches less door width (LDW) at single doors when mounted on push side.
 - 1. 1 inch LDW at pairs and when mounted on pull side.
- E. Metal Properties: Stainless steel.
 - 1. Metal, Standard Duty: Thickness 0.05 inch, minimum.
- F. Edges: Beveled, on four sides unless otherwise indicated.
- G. Fasteners: Countersunk screw fasteners.

2.15 DOOR HOLDERS

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Trimco: www.trimcohardware.com.
 - 3. Substitutions: Not permitted.
- B. 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: Aluminum.

2.16 ELECTROMAGNETIC DOOR HOLDERS

- A. Manufacturers:

1. Rixson; an Assa Abloy Group company; 998 Series: www.assaabloydss.com.
 2. Sargent; an Assa Abloy Group company; 1561 Series: www.assaabloydss.com.
 3. Substitutions: Not permitted.
- B. Electromagnetic Door Holders: Comply with BHMA A156.15.
1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
 2. Holding Force, Standard Duty: 40 lbs-force, minimum.
 3. Voltage: 12 VDC, and provide power supplies by same manufacturer as holders.
 4. Fail safe; door released to close automatically when electrical current is interrupted.
 5. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.
 - a. Review templates and installation instruction guide prior to installing the product so proper alignment of the junction box, door armature and electromagnet can be achieved.

2.17 WALL STOPS

- A. Manufacturers:
1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
 2. Trimco: www.trimcohardware.com.
 3. Substitutions: Not permitted.
- B. 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.

2.18 THRESHOLDS

- A. Manufacturers:
1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
 2. Substitutions: Not permitted.
- B. 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 30-35 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, flat head or countersunk fasteners at exterior locations.

2.19 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:
 - 1. Pemko (PE); an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Substitutions: Not permitted.
- B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
 - 1. Head and Jamb Type: Adjustable.
 - 2. Door Sweep Type: Encased in retainer.
 - 3. Material: Aluminum, with brush weatherstripping.
 - 4. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
 - 5. Provide frame-applied intumescent gasketing on wood doors that are labeled as smoke and draft control doors (Indicated as "S" on Drawings), unless otherwise indicated.
 - 6. Refer to Section 08 1416 when wood door to frame sealing system is applied by door manufacturer.
 - 7. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .
 - 8. Provide door bottom sweep on each exterior door, unless otherwise indicated.
 - 9. 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.

2.20 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.

2.21 KEY CONTROL SYSTEMS

- A. Key Control Systems: Comply with guidelines of BHMA A156.28.
 - 1. Provide keying information in compliance with DHI (KSN) standards.
 - 2. Existing System: Key locks to District's existing system.
 - 3. Keying: Grand master keyed.
 - 4. 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.
 - 5. Key to existing keying system.

- a. Factory registered master key system.
 - b. Schlage 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.
6. Supply keys in following quantities:
 - a. 5 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.
 7. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
 - a. Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, and permanent markers.
 - b. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge.
 - 1) Provide factory key system formatted for importing into "Key Wizard" software.
 8. 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.
 9. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
 10. Deliver keys with identifying tags to District by security shipment direct from hardware supplier.
 11. Bitting List: Use secured shipment direct from point of origination to District upon completion.
 12. 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."
 13. District or District's agent install permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

2.22 KEY CABINET

- A. Manufacturers:
 - 1. Lund Equipment (LU): www.lundkeycab.net.
 - 2. Telkee (TK): www.telkee.com.
 - 3. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. 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 50 percent additional capacity.
 - 3. Size: 14-1/2 inches wide by 18 inches high by 5 inches deep.
 - 4. Horizontal metal hook strips with replaceable labels covered with clear plastic.
 - 5. Size key hooks to hold 6 keys each.
 - 6. Finish: Baked enamel, manufacturer's standard color.
 - 7. Key cabinet lock to building keying system.

2.23 FIRE DEPARTMENT LOCK BOX

- A. Manufacturers:
 - 1. Knox Company; Knox-Box Rapid Entry System; Model 3227: www.knoxbox.com.
 - 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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.
- C. Fire Department Lock Box: at Buildings or Site Walls
 - 1. Heavy-duty, surface mounted, 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.
- D. 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).

2.24 POWER SUPPLY

- A. Power Supply: Hard wired, with multiple zones providing eight (8) breakers for each output panel with individual control switches and LED's; UL (DIR) Class 2 listed.
 1. Power: 24 VAC, 10 Amp; with 120 VAC power supply.
 2. Operating Temperature: 32 to 110 degrees F.
 3. Provide with emergency release terminals that release devices upon activation of fire alarm system.

2.25 FINISHES

- A. Finishes: Identified in Section 08 06 71 - 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.
- B. Verify that electric power is available to power operated devices and of correct characteristics.

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. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
 - c. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
 - d. 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. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

- C. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- D. Use templates provided by hardware item manufacturer.
- E. Do not install surface mounted items until application of finishes to substrate are fully completed.
- F. 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 1010.1.9.2, 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: Refer to Section 08 11 13.
 - 4. For Aluminum-Framed Storefront Doors and Frames: Refer to Section 08 43 13.
 - 5. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
 - 6. Flush Wood Doors: Refer to Section 08 14 16.
 - 7. Mounting heights in compliance with ADA Standards:
 - 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.
- G. 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. Refer to Section 07 92 00 for additional requirements.
- H. Locate floor stops no more that 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.
- I. 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 45 00 - Quality Control.
- 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 delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
 - d. Adjust door closers per "Commissioning" article below.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.
- D. Fire-rated doors (NFPA 80):
 1. Wood Doors: Adjust to 1/8 inch clearance at heads, jambs, and meeting stiles.
 2. Steel Doors: Adjust to 1/16 inch minimum to 3/16 inch maximum clearance at heads, jambs, and meeting stiles.
 3. Adjust wood and steel doors to 3/4 inch maximum clearance (undercut) above threshold or finish floor material under door.
- E. Inspection of fire door assemblies and means-of-egress panic-hardware doors:
 1. Per NFPA 80 5.2.1:
 - a. Provide an independent third-party inspection service to prepare a report listing these doors, and include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware.
 - b. Certification, Testing and Quality Control shall be in accordance with Section 01 45 00 - Quality Control.
 - c. All doors hardware and installation will be inspected by a third party selected by the Architect/District.
- F. 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, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
 2. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.
 3. Inspection of fire door assemblies and means-of-egress panic-hardware doors:
 - a. Contractor shall provide an independent third-party inspection service to prepare a report listing the proper operation and functionality of these doors.

- b. Include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware.
- 4. 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.

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.

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 and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework: Cabinets with requirements for glass shelves.
- B. Section 07 25 00 - Weather 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 42 29 - Automatic Entrances: Glazing furnished as part of door assembly.
- G. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.
- H. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.
- I. Section 10 28 00 - Toilet Accessories: Mirrors.

1.03 REFERENCE STANDARDS

- A. 28 CFR 35 - Structural Sealant Glazing Systems; 1985 (R2006).
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
 - 1. Use 2014 as indicated in 2016 CBC Referenced Standards.
- C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
 - 1. Use 2012ae1 as indicated in 2016 CBC Referenced Standards.

- I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- J. GANA (GM) - GANA Glazing Manual; 2009.
- K. GANA (SM) - GANA Sealant Manual; 2008.
- L. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.
- M. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).
- N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.
- O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.
- P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

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 33 00 - Submittal Procedures, 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 8 by 8 inch in size of glass units.
- E. Samples: Submit 4 inch long bead of glazing sealant, color as selected.
- F. Samples: Submit two samples, 12 inch long strip of representative material of adjoining material., color as selected.
- G. Certificate: Certify that products of this section meet or exceed specified requirements.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.
- K. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), 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.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and personnel certified under the National Glass Association's Certified Glass Installer program.
- 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 45 00 - Quality Control, for additional mock-up requirements.
- B. Preconstruction Testing: Glazing material, tape sealant, gasket, glazing accessory and glass framing member for adhesion. No fewer than 8 samples of each material.
- C. Locate where directed.
- D. 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 77 00 - Closeout Procedures, 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. Spandrel Glass: Provide manufacturer's warranty covering deterioration due to normal conditions of use and not to handling, installing and cleaning practices contrary to the glass manufacturer's published instructions.
- D. Remedial Provisions: Upon notification of defects, within the warranty period, party providing warranty or guarantee shall replace the glass and glazing at no cost to District.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Fabricators:
 - 1. Glasswerks Inc.: www.glasswerks.com.
 - 2. GlasPro, Inc.: www.glas-pro.com
 - 3. Viracon, Inc: www.viracon.com.
 - 4. Substitutions: Refer to Section 01 63 00 - Product Substitution Procedures.
- B. Float Glass Manufacturers:
 - 1. AGC Glass Company North America, Inc: www.us.agc.com.
 - 2. Cardinal Glass Industries: www.cardinalcorp.com.

3. GlasPro, Inc.: www.glas-pro.com
4. Guardian Industries Corp: www.sunguardglass.com.
5. Pilkington North America Inc: www.pilkington.com/na.
6. Vitro Architectural Glass, formerly PPG Industries, Inc: www.vitroglazings.com.
7. Substitutions: Refer to Section 01 63 00 - Product Substitution Procedures.

2.02 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 28 CFR 35 CI and CII.
- B. Where safety glass is indicated or required, provide glazing materials that conform to ANSI Z97.1 and CPSC 28 CFR 35 and are so identified in accordance with CBC Section 2406.3.
- C. Glass Identification:
 1. Per CBC Section 2403.1, each light shall bear the manufacturer's label designating the type and thickness of glass.
 - a. 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.
 - b. 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.
 - c. The label shall be legible and visible from the inside of the building after installation and shall specify that label shall not be removed.
 - d. Tempered glass shall have an etched manufacturer's label.

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 applicable codes.
 - 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. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 - a. Refer to Section 07 25 00.
 2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.
 3. To maintain a continuous vapor retarder and air barrier throughout the 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. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 28 CFR 35 criteria for safety glazing used in hazardous locations.
 - a. Where fully tempered is indicated, provide glass that has been tempered by the tong-less horizontal method.
 4. Impact Resistant Safety Glass: Complies with ANSI Z97.1 and 28 CFR 35 criteria; Class A/Category II.
 5. Spandrel Type: ASTM C1036, Type 1, Class 1, Quality-Q3, heat treated in compliance with ASTM C1048, Kind HS, Condition B, with colored ceramic frit coating heat fused to interior surface in accordance with ASTM C1376.
 6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.05 INSULATING GLASS UNITS

- A. Manufacturers:
1. Any of the manufacturers specified for float glass.
 2. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

3. AGC Glass North America, Inc: www.agcglass.com/#sle.
 4. Cardinal Glass Industries: www.cardinalcorp.com.
 5. Glasswerks: glasswerks.com.
 6. Guardian Industries Corp: www.sunguardglass.com.
 7. Pilkington North America Inc: www.pilkington.com/na.
 8. Viracon, Apogee Enterprises, Inc: www.viracon.com.
 9. Vitro Architectural Glass, formerly PPG Industries, Inc: www.vitroglazings.com/#sle.
 10. Substitutions: Refer to Section 01 63 00 - Product Substitution Procedures.
- B. 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, mitered and spigoted corners.
 4. Spacer Color: Black.
 5. Edge Seal:
 - a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.
 6. Color: Black.
 7. Purge interpane space with dry air, hermetically sealed.
- C. Type GL-2 - Insulating Glass Units: Spandrel glazing.
1. Applications: Exterior spandrel glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Heat-strengthened 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. Basis of Design Product: "On the Rocks" as manufactured by Glas-Pro, or approved equal.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 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), Winter - 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. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 14. Color: Black.
 15. Purge interpane space with dry air, hermetically sealed.
- B. Basis of Design - Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
1. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Low-E Coating: Vitro Architectural Glass (formerly PPG Glass) Solarban 70XL on #2 surface.
 - b. Glass: Clear.
 2. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Coating: No coating on inboard lite.
 - b. Glass: Clear.
 3. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another acceptable manufacturer.
 4. Substitution Procedures: See Section 01 63 00 - Product Substitution Procedures.
 - a. 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: Fully tempered float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
 5. Glazing Method: Dry glazing method, gasket glazing.
- 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 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.

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. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. 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, etc.

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 45 00 - Quality Control, 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 non-permanent 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 08 87 33
ARCHITECTURAL DECORATIVE WINDOW FILMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior Window Film.
- B. Decorative Window Film.
- C. Privacy Window Film.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed doors and borrowed lites to receive architectural window film.
- B. Section 08 14 16 - Flush Wood Doors: Glazed doors to receive architectural window film.
- C. Section 08 43 13 - Aluminum-Framed Storefronts: Windows to receive architectural window film.
- D. Section 08 80 00 - Glazing: Glass to receive architectural window film.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

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 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets on each product to be used.
- C. Shop Drawings:
 - 1. Submit shop drawings covering fabrication, installation and finish of specified systems.
 - 2. Include fully dimensioned plans and elevations with material coordination keys.
- D. Samples:
 - 1. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - 2. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.
- E. Manufacturer's Qualification Statement.
- F. Specimen Warranty.
- G. Installer's Qualification Statement.
- H. Manufacturer's Instructions:

1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- I. Maintenance Data: Operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
 - J. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.

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. Installer Qualifications: Company specializing in performing the work of this section and approved by manufacturer.
 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 2. Provide a commercial building reference list of five (5) properties where the installer has applied window film. This list will include the following information:
 - a. Name of building.
 - b. The name and telephone number of a management contact.
 - c. Type of glass.
 - d. Type of film.
 - e. Amount of film installed.
 - f. Date of completion.
- C. Single-Source Responsibility: For each separate film graphic type required from one source of a single manufacturer.

1.07 MOCK-UP

- A. Provide window film mock-up, one complete window, illustrating installation for evaluation of surface preparation techniques and application workmanship.
- B. Locate where directed.
- C. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
- D. Refinish mock-up area as required to produce acceptable work.
- E. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
- C. Product must remain in original plastic bag and boxes and have storage conditions as follows:
 1. 40°F (5°C) - 90°F (32°C) storage temperature range

2. Out of Sunlight
3. Clean dry area
4. Original container
5. Do not stack boxes over six (6) units high. Excessive weight can damage the film
6. Products are not recommended for interior applications where condensation consistently occurs.
7. Handle products in accordance with manufacturer's instructions.
8. Total pre-installation shelf life: 2 years. Up to 2 years unprocessed, OR process within 1 year and apply within 1 year of processing.

1.09 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. Application temperature range is from 53 to 100 degrees F (12 to 38 degrees C).
- B. Environmental Limitations: Do not install until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.10 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 thermal shock fracture, appearance, adhesion, and solar reflective properties.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials Basis of Design: 3M Window Film: www.3m.com/windowfilm.
 1. Local Representative: 3M Window Film Point of Contact – Michael Hassenauer
651.737.1053. Email: mjhassenauer@mmm.com.
- B. Manufacturers:
 1. Flexvue Films: www.flexvuefilms.com.
 2. Madico, Inc: www.madico.com.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E84:
 1. Flame Spread: 25, maximum.
 2. Smoke Developed: 450, maximum.

2.03 MATERIAL PROPERTIES

- A. General: Glass and plastic finishes field-applied application to glass or plastic material as visually opaque or decorative film.
- B. Film (Fasara): Polyester.
- C. Decorative Pattern: Printed.
- D. Adhesive: Acrylic, Pressure Sensitive.
- E. Liner (Fasara): Transparent Polyester.
- F. Liner (Crystal): Silicone-coated Polyester.
- G. Average Overall Thickness (Film and Adhesive without Liner):
 - 1. Fasara: 3.2 mils (0.08 mm)

2.04 FABRICATION

- A. Shop fabrication and tolerances for graphic artwork shall conform to the standards of the industry. All items shall be shop fabricated so far as practicable. Perform high-quality, professional workmanship. Fabricate work to proper proportions, with orientation that will be straight, plumb, level and square and to sizes, shapes and profiles indicated on the approved shop drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify pattern prior to material acquisition.
- B. Confirm appropriate substrate is suitable for mounting of glass finish components prior to start of installation.
- C. Examine substrate(s) for compliance. Do not proceed with installation until unsatisfactory conditions have been corrected.
- D. Reference 3M Technical Data Sheet to determine compatibility of finish to substrate
- E. Responsibility for state of surfaces prior to installation to be pre-determined by installation specialist.
- F. Do not proceed with installation until unsatisfactory conditions have been corrected.
- G. Proceeding with installation implies installer's acceptance of substrate and conditions.

3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Thoroughly clean substrate of substances that could impair the overlay's bond, including mold, mildew, oil, grease.
- C. Re-clean surfaces with appropriate surface prep solvent and remove any haze or surface contamination.

3.03 INSTALLATION

- A. Application must be performed by qualified installer.
- B. Do not proceed with installation until all finishing work has been completed in and around the work area.
- C. Install in accordance with manufacturer's instructions.
- D. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
- E. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
- F. Apply film to glass and lightly spray film with slip solution.
- G. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
- H. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
- I. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
- J. Refer to the applicable manufacturer's Installation Guide for additional details.

3.04 CLEANING

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application.
 - 1. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film.
 - 2. Use synthetic sponges or soft cloths.

3.05 EXTRA MATERIALS

- A. Furnish 2 percent extra material at time of installation. Deliver in protective packaging for storage and label contents appropriately.

END OF SECTION

SECTION 08 91 00
LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Sealing frames to weather barrier installed on adjacent construction.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim.
- C. Section 08 43 13 - Aluminum-Framed Storefronts: Prepared openings for louvers.
- D. Section 08 44 13 - Glazed Aluminum Curtain Walls: Prepared openings for louvers.
- E. Section 09 91 13 - Exterior Painting: Field painting.
- F. Division 23 - Mechanical: Ductwork attachment to louvers , and blank-off panels.

1.03 REFERENCE STANDARDS

- A. AATCC Test Method 134 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
 - 2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
 - 3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
 - 4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
- B. Stationary Louvers: Horizontal blade, formed galvanized steel sheet construction, with intermediate mullions matching frame.
 - 1. Free Area: 50 percent, minimum.
 - 2. Blades: Drainable.
 - 3. Frame: 4 inches deep, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
 - a. Frames shall be joined at each corner with a full width fillet weld.
 - 4. Steel Thickness, Galvanized: Frame 16 gage, 0.0598 inch minimum base metal; blades 16 gage, 0.0598 inch minimum base metal.
 - 5. Steel Finish: Superior performing organic coatings, finished after fabrication.

2.03 MATERIALS

- A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.04 FINISHES

- A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AATCC Test Method 134, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: As selected from manufacturer's standard colors.

2.05 ACCESSORIES

- A. Blank-Off Panels: Same material as louver, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
- C. Insect Screen: 18 x 16 size aluminum mesh.
- D. Fasteners and Anchors: Stainless steel.
- E. Head and Sill Flashings: See Section 07 62 00.
- F. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Coordinate with installation of flashings by others.
- C. Install louvers level and plumb.
- D. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Coordinate with installation of mechanical ductwork.

3.03 ERECTION TOLERANCES:

- A. Maximum variation from plane or location shown on the approved shop drawings: 1/8 inch per 12 feet of length, but not exceeding 1/2 inch in any total building length or portion thereof (non-cumulative).
- B. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3 inch: 1/16 inch (shop or field joints). This limiting condition shall prevail under both load and no load conditions.

3.04 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

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.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile and stone tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. 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.
- E. Patching compound.
- F. Remedial floor coatings.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 00 - Quality Control: Additional requirements relating to testing agencies and testing.
- B. 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.
- C. Section 03 30 00 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.
- 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 2-in. or (50-mm) Cube Specimens); 2016a.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

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. Visual Observation Report: For existing floor coverings to be removed.
- B. 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.
- C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 - 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 4. Manufacturer's installation instructions.
 - 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- D. 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. Product data for recommended remedial coating.
 - 7. Include certification of accuracy by authorized official of testing agency.
 - 8. Submit report directly to District.
 - 9. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. 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. 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.
- 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 MC RAPID: 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 NXT Vapor Reduction Coating with LATICRETE NXT Level Plus: www.laticrete.com/#sle.
 - f. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: www.laticrete.com/#sle.
 - g. Maxxon Corporation; Maxxon MVP: www.maxxon.com.
 - h. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
 - i. Tnemec Company, Inc; Series 208 Epoxoprime MVT: www.tnemec.com/#sle.
 - j. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Cementitious Patching Compound: 100-percent Portland cement-based self-leveling compound capable of providing adequate bond for subsequently applied floor adhesives; approved by remedial coating manufacturer.
1. Products:
 - a. ARDEX Engineered Cements, Inc; ARDEX K-15: www.ardexamericas.com.
 - b. Mapei International; Mapei Ultraplan 1 Plus: www.mapei.com.
 - c. Sika Corporation; Sika Level-315: www.sikafloorusa.com.
 - d. 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. Preliminary cleaning.
 - 2. 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.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Specified remediation, if required.
 - 6. Patching, smoothing, and leveling, as required.
 - 7. Other preparation specified.
 - 8. Adhesive bond and compatibility test.
 - 9. 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 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.

3.03 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.

3.04 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.

3.05 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.

3.06 PREPARATION

- A. See individual floor covering section(s) for additional requirements.

- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 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.

3.09 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16
GYP SUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Shaft wall system.
 - 1. Elevator shaft enclosures.
 - 2. Service shaft enclosures (for piping, ductwork, air plenums, electrical conduit and similar services).
 - 3. Stairwell enclosures.
 - 4. Structural column enclosures (fireproofing).
- E. Acoustic insulation.
- F. Gypsum sheathing.
- G. Cementitious backing board.
- H. Gypsum wallboard.
- I. Joint treatment and accessories.
- J. Vapor-Retarder barrier over interior wall at Cold Lab 1278, Storage 1279, and Janitor 1280.
- K. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- B. Section 06 10 00 - Rough Carpentry: Building framing and sheathing.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- D. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- E. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- F. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- G. Section 09 30 00 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

- A. ACI 308R - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- B. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

- D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
 - 1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- G. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2014).
 - 1. Use 2004 (Reapproved 2009)e1 as indicated in 2016 CBC Referenced Standards.
- H. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).
 - 1. Use 2003 (Reapproved 2009)e1 as indicated in 2016 CBC Referenced Standards.
- I. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- J. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
 - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
 - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- M. 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; 2015.
 - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- N. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
 - 1. Use 2007 as indicated in 2016 CBC Referenced Standards.
- O. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- P. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
 - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- Q. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2007a (Reapproved 2015).
 - 1. Use 2007a(Reapproved 2011) as indicated in 2016 CBC Referenced Standards.
- R. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2013a.

- S. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2014.
 - 1. Use 2008b as indicated in 2016 CBC Referenced Standards.
- T. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- U. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.
 - 1. Use 2006(Reapproved 2011) as indicated in 2016 CBC Referenced Standards.
- V. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2013.
 - 1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- W. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- X. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.
- Y. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
 - 1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- Z. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
 - 1. Use 2009 as indicated in 2016 CBC Referenced Standards.
- AA. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- AB. GA-216 - Application and Finishing of Gypsum Board; 2013.
 - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- AC. GA-600 - Fire Resistance Design Manual; 2015.
 - 1. Use 2009 as indicated in 2016 CBC Referenced Standards.
- AD. UL (FRD) - Fire Resistance Directory; current edition.
- AE. United States Gypsum Co. (USG) Specification and Technical Bulletins No. SA 923, No. SA 924, and No. SA 925, as applicable for materials location, installation and condition of construction.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.
 - 1. Joint Treatment Materials: Submit manufacturer's product data, indicating VOC content.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Application Procedures: Submit a general written description of procedures to be followed where fire-rated work is being done and where alternative assemblies are proposed.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of experience.
- B. Regulatory Requirements: Conform to California Building Code (CBC), Title 24, Part 2, Chapter 7 and Chapter 25, as amended and adopted by authorities having jurisdiction.
- C. Fire Resistance Rating:
 - 1. Certain partition constructions gypsum wallboard systems are required to meet fire resistive requirements of ASTM E119 and applicable building Codes.
 - 2. Construction which forms component parts of such assemblies shall be constructed to afford the fire resistance required by Code for the location and condition of construction indicated.
 - 3. See required ratings and designs on Drawings.
 - 4. Construction shall conform to requirements of these tested assemblies.
 - 5. Fire Resistive Gypsum Board: Material shall bear the Underwriters' Laboratories, Inc. (UL) label or label of other testing organization acceptable to the State Fire Marshal.
- D. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 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.

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. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

- D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Intermittent loads of 15 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- E. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
 - 1. CBC Chapter 7 Item Numbers: Comply with applicable requirements of CBC Chapter 7 Tables for the particular assembly; as indicated on Drawings.
 - 2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly; as indicated on Drawings.
 - 3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD); as indicated on Drawings.

2.02 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - 1. Products:
 - a. Same manufacturer as other framing materials.
 - 2. Gypsum Shaft Wall System: Characteristics of selected components are described below for purposes of indicating discrete gypsum board shaft wall systems which are manufacturers' standard assemblies. Provide complete shaft wall systems which comply with requirements indicated.
 - 3. Cavity Shaft Wall Systems: Provide assemblies consisting of gypsum shaft wall boards inserted between U- or J-shaped metal floor and ceiling tracks; with specially shaped studs engaged in tracks and fitted between shaftwall boards; and gypsum boards on finished side or sides applied to studs in number of layers, thicknesses and arrangement indicated.
 - a. Stud Shape:
 - 1) I, C-H or double E.
 - b. Stud Thickness, minimum thickness of base metal, or as required for span:
 - 1) 0.0329-inch
 - c. Stud Depth: Not less than;
 - 1) 4 inches.

- 2) 6 inches.
 - 3) As indicated.
 - d. Room-Side Finish:
 - 1) As indicated on Drawings and to match surrounding and adjacent finishes.
 - 2) One layer of 5/8-inch thick gypsum board.
 - 3) Two layers of 5/8-inch thick gypsum board.
 - 4) As indicated on Drawings.
 - e. Shaft-Side Finish: One layer 5/8-inch gypsum board; provide only where finish is indicated on shaft side as well as room side, otherwise leave exposed.
 - f. Cavity Insulation: Provide sound attenuation blankets in cavity formed by studs between shaftwall board and room-side finish.
- D. Partial-Height Wall Brace: Provide steel post as indicated on Drawings.
- 1. Alternate method: Provide a premanufactured wall brace compliant with CBC Section 1607A.7.1 from:
 - a. USG, Inc.; www.usg.com.
 - b. The Steel Network, Inc.; MidWall; www.steelnetwork.com.
- E. Sheet Metal Backing: 54 mil (0.0566) inch thick, galvanized for attachment and support of products to be attached to framing..
- 1. 16 gage(54-mil) material covering full width of stud spacing by 6 inches wide minimum.
 - 2. 6 by 1-1/4 inch by 14 gage flush mount backing with pre-punched screw holes, FLUSH-MOUNT Backing by Metal-Lite Inc., www.metal-lite.net or approved equivalent.
 - 3. As indicated on Drawings.
- F. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- G. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
- 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
 - 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 - 4. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
 - b. Products:
 - 1) BlazeFrame: "BlazeFrame"; www.blazeframe.com.
 - 2) CEMCO: "FAS Track 500"; www.cemcosteel.com.
 - 3) FireTrak Corporation; Posi Klip.
 - 4) Metal-Lite, Inc; The System.
 - 5) Rectorseal, Inc.; Track-Safe: www.biofireshield.com.
 - 6) Substitutions: See Section 01 63 00 - Product Substitution Procedures.

- H. Preformed Top Track Firestop Seal:
 - 1. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 - 2. Products:
 - a. Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.03 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. Continental Building Products: www.continental-bp.com/#sle.
 - 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 4. National Gypsum Company: www.nationalgypsum.com/#sle.
 - 5. PABCO Gypsum: www.pabco gypsum.com/#sle.
 - 6. USG Corporation: www.usg.com/#sle.
 - 7. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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 at all locations.
 - 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
 - 5. Mold Resistant Paper Faced Products:
 - a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - b. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
 - c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
 - d. National Gypsum Company; Gold Bond XP Gypsum Board.
 - e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Impact Resistant Wallboard:

1. Application: High-traffic areas indicated, typical at corridors and storage rooms unless noted otherwise.
 - a. Provide up to 96 inches, minimum.
 2. Surface Abrasion: Level 3, 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 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 5. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 7. Glass Mat-Faced Type: Gypsum wallboard as defined in ASTM C1658/C1658M.
 8. Unfaced Type: Interior fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M.
 9. Type: Fire resistance rated Type X, UL or WH listed.
 10. Thickness: 5/8 inch.
 11. Edges: Tapered.
 12. Products:
 - a. National Gypsum Company; Gold Bond HI-Impact XP Gypsum Board.
 - b. USG Corporation; Fiberock Brand Panels--VHI Abuse-Resistant.
 - c. USG Corporation: Sheetrock Brand Mold Tough Gypsum Panels Hi-Impact.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- E. Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas including locations where noted.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. 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) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com/#sle.
 - 3) USG Corporation; Durock Cement Board Next Gen: www.usg.com.
 - 4) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Type X Thickness: 5/8 inch.
5. Regular Board Thickness: 5/8 inch.
6. Edges: Tapered.
7. Products:
 - a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - b. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board.
 - c. Lafarge North America Inc; Mold Defense Drywall.
 - d. National Gypsum Company; Gold Bond XP Gypsum Board.
 - e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- G. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 1/2 inch.
 3. Edges: Tapered.
 4. Products:
 - a. CertainTeed Corporation; ProRoc Interior Ceiling.
 - b. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
 - c. National Gypsum Company; High Strength Brand Ceiling Board.
 - d. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
- H. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper faced, high density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. Products:
 - a. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board: www.nationalgypsum.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- I. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
 1. Application: Exterior sheathing, unless otherwise 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. Core Type: Regular and Type X, as indicated.

5. Type X Thickness: 5/8 inch.
6. Regular Board Thickness: 1/2 inch.
7. Edges: Square, for vertical application or horizontal.
8. Glass Mat Faced Products:
 - a. CertainTeed Corporation; GlasRoc Brand.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - c. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing.
 - d. National Gypsum Company; Gold Bond eXP Sheathing.
 - e. USG Corporation: Securock Brand Glass Mat Sheathing.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- J. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
 1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 2. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 - a. Application: Elevator shafts.
 3. Paper-Faced Products:
 - a. CertainTeed Corporation; M2Tech Type X Shaftliner.
 - b. Georgia-Pacific Gypsum; ToughRock Shaftliner.
 - c. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
 - d. USG Corporation; Sheetrock Gypsum Liner Panels.
 - e. USG Corporation; Sheetrock Gypsum Liner Panels--Enhanced (mold-resistant).
 4. Glass Mat Faced Products:
 - a. National Gypsum Company; Gold Bond Brand eXP Shaftliner.

2.04 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-1/2 inch.
 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. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

- B. Sealants: For penetrations at fire-rated construction, provide firestopping as specified in Section 07 84 00 - Firestopping.
- C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 1. Non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
 - 2. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following acoustical sealants for concealed joints:
 - a. Products:
 - 1) Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com/#sle.
 - 2) Liquid Nails, a brand of PPG Architectural Coatings; AS-825 Acoustical Sound Sealant: www.liquidnails.com/#sle.
 - 3) Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
 - 4) Pecora Corp.; BA-98.
 - 5) Tremco, Inc.; Tremco Acoustical Sealant.
 - 6) USG Corporation; USG Sheetrock Acoustical Sealant
 - 7) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. 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.
- E. Vapor-Retarder Barrier: No. 15 asphalt felt.
 - 1. Vapor Retarder Sheet: ASTM D4397 polyethylene film reinforced with glass fiber square mesh, clear.
 - a. Thickness: 20 mil, 0.020 inch.
 - b. Water Vapor Permeance:
 - 1) Class I – Very low permeability vapor retarders – rated at 0.1 perms or less. Sheet polyethylene or unperforated aluminum foil (FSK) are Class I vapor retarders.
 - c. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2 inches wide, compatible with sheet material.
- F. Beads, Joint Accessories, and Other Trim: ASTM C1047, aluminum or 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. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 2. Rigid 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. Reveal Depth: 1/2 inch.
 - b. Shapes: As indicated on drawings.
 - c. 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.
 - d. Materials and Finish:
 - 1) Interior Aluminum Surfaces: Extruded; Clear medium etched.
 - (a) Architectural 200R1 medium etch: ACI 308R AA-M32C10A21 Clear color.
 - (b) Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.
- G. 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: Drying type, vinyl-based, ready-mixed.
 - a. USG Easy Sand, Durabond 45 or 90 joint compound, or equal as approved by Architect.
 - b. Products:
 - 1) CertainTeed Corporation; Extreme All-Purpose Joint Compound: www.certainteed.com/#sle.
 - 2) Continental Building Products: www.continental-bp.com/#sle.
 - 3) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 - 3. Joint Compound: Setting type, field-mixed.
- H. High Build Drywall Surfer: 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/Surfer with M2Tech: www.certainteed.com/#sle.
 - b. USG Corp.; Sheetrock® Brand Tuff -Hide™ Primer-Surfer: www.usg.com
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

- I. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- J. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954, Type W; steel drill screws, corrosion resistant.
- K. Nails for Attachment to Wood Members: ASTM C514, as required for fire-resistive construction.
- L. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- M. Adhesive for Attachment to Metal:
 - 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.
 - 2. Products:
 - a. Franklin International, Inc; Titebond PROvantage Professional Drywall Adhesive: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings; DWP-24 Drywall Construction Adhesive: www.liquidnails.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. 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.
- C. Examine substrates which gypsum board wall or shaft wall construction attaches to or abuts, including the following.
 - 1. Preset hollow metal frames
 - 2. Elevator hoistway door frames
 - 3. Cast-in-anchors.
 - 4. Structural framing, including sprayed fireproofing.
 - 5. Steel stairs.
 - 6. Piping.
 - 7. Conduit.

- 8. Ductwork.
- D. Beginning of installation means acceptance of substrate.
- 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 SHAFT WALL INSTALLATION

- A. Verify compliance with requirements for installation tolerances and other conditions affecting performance of shaft wall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
 - 2. Install studs at spacing required to meet performance requirements.
- C. Provisions at Expansion Joints: Do not bridge building expansion joints with shaft wall system, frame both sides of joints with furring and other support as indicated.
- D. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
 - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant at non-rated assemblies.
 - 3. Seal perimeter of shaft wall and penetrations with fire-rated sealant at fire-rated or smoke rated assemblies.
- E. Backing, Blocking and Bracing: Install supplementary framing, blocking and bracing to support gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings and similar Work which cannot be adequately supported directly by regular framing of gypsum board shaft wall system.
 - 1. Support elevator hoistway door frames independently of shaft wall framing system, or reinforce system in accordance with system manufacturer's instructions.
 - 2. Where handrails are indicated for direct attachment to gypsum board shaft wall system, provide not less than a 0.0341 inch thick by 4 inch wide galvanized steel reinforcement

strip, accurately positioned and secured behind not less than one gypsum board face layer of 1/2 or 5/8 inch thickness.

- F. Installation Coordination with Steel Stairs: Integrate stair hanger rods with gypsum board shaft wall system where indicated (and where possible); by locating cavity of system as required to enclose rods.
- G. Shaft Wall Penetrations: At penetrations in shaft wall, maintain fire resistance rating of entire shaft wall assembly by installing supplementary fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items. See also Section 07 84 00 - Firestopping.
- H. Shaft Wall Structural Isolation: Isolate shaft wall system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading. Comply with details shown and with manufacturer's instructions.
- I. Perimeter Sealing: Seal gypsum board shaft walls at perimeter of each section which abuts other work and at joints and penetrations within each section. Install acoustical sealant to withstand dislocation by air pressure differential between shaft and external spaces; comply with manufacturer's instructions and ASTM C919.
- J. Elevator Shaft Projections: In elevator shafts where gypsum board shaft wall system cannot be positioned within 2 inches of shaft face of structural beams, floor edges and similar projections into shaft, install 1/2 or 5/8 inch thick gypsum board cants covering tops of projections as follows:
 - 1. Slope cant panels not more than 15 degrees from vertical. Set base-edge of panels in gypsum board adhesive and secure top edges to shaft walls at 24 inches on center with screws fastened to shaft wall framing.
 - 2. Where cants exceed 2 inches, support gypsum board with steel studs spaced 24 inches on center; extend studs from top of projection to shaft wall framing behind cant.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
 - 3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

- E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 - 1. Orientation: Vertical.
 - 2. Spacing: As indicated.
- F. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
- G. Blocking: Install wood blocking (backing) for support of:
 - 1. Framed openings.
 - 2. Wall mounted cabinets.
 - 3. Plumbing fixtures.
 - 4. Toilet partitions.
 - 5. Toilet accessories.
 - 6. Wall mounted door hardware.
 - 7. Wall mounted equipment
 - 8. Wall mounted handrails
 - 9. Other locations, where indicated.
 - 10. Where sheet steel blocking(backing) is used on a wall with level 5 surface finish, provide shims between stud face and gypsum board panel to maintain a visually smooth level surface.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

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

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
 - 1. Comply with USG Specification and Technical Bulletins No. SA 923, No. SA 924, and No. SA 925, as applicable for materials location, installation and condition of construction.
- B. Regulatory Requirements: Install gypsum board products in accordance with applicable Code requirements and requirements of listed assemblies shown on Drawings.

- C. Single-Layer Non-Rated: Install gypsum board in most economical direction, with staggered 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 Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- E. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
 - 1. Single Layer: Install and fasten gypsum board in accordance with CBC Title 24, Part 2, Table 7-B for steel or wood construction. Install gypsum board vertically, with edges and ends occurring over firm bearing.
 - 2. Double Layer: Install and fasten gypsum board in accordance with CBC Title 24, Part 2, Table 7B. Install base layer horizontally with ends occurring over firm bearing. Install face layer vertically with ends and edges occurring over firm bearing. Stagger joints 24 inches each side and opposite sides. Attach with required screws.
- F. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- G. 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.
- H. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- I. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- J. 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.
- K. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
 - 1. Single-Layer Applications: Adhesive application.
 - 2. Double-Layer Application: Install base layer using screws or nails. Install face layer using adhesive.

3.06 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 over 50 feet long.
- C. Corner Beads: Install at external corners, using longest practical lengths.
- D. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 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 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 3: Walls to receive textured wall finish or heavy textured paint.
 - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- 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 is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 8. Taping, filling and sanding is not required at base layer of double layer applications.
- E. 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.

3.08 TOLERANCES

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

3.09 REPAIR, CLEAN-UP AND PROTECTION

- A. 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.
- B. Upon completion of the work, remove from adjacent surfaces, overspray, splatter and daubs of taping and finish compound and textured finishes. Remove tools, equipment, unused material and cuttings and leave the work in a clean orderly manner.

END OF SECTION

SECTION 09 22 36.23

METAL 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 06 10 00 - Rough Carpentry: Sheathing on exterior walls.
- B. Section 07 25 00 - Weather Barriers: Weather barrier under exterior plaster and stucco.
- C. Section 08 31 00 - Access Doors and Panels: Product requirements for metal access panels integral with metal lath.
- D. Section 09 21 16 - Gypsum Board Assemblies: Sheathing on exterior walls.
- E. Section 09 24 00 - Cement Plastering.

1.03 REFERENCE STANDARDS

- A. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2003 (Reapproved 2013).
 - 1. Use 2003(2013) as indicated in 2016 CBC Ch. 35 Referenced Standards.
- D. ASTM C847 - Standard Specification for Metal Lath; 2014a.
 - 1. Use 2012 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- E. 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; 2015.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
 - 1. Use 2007 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- G. ASTM C1032 - Standard Specification for Woven Wire Plaster Base; 2014.
- H. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2016c.
 - 1. Use 2012d as indicated in 2016 CBC Ch. 35 Referenced Standards.
- I. Plaster Assemblies Manual - Technical Information Services Bureau (TSIB) of Western Walls & Ceilings Contractors Association (WWCCA); Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 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: All products listed are "or equal".
 - 1. Brand X Metals: www.brandxmetals.com.
 - 2. Cemco: www.cemcosteel.com/#sle.
 - 3. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com/#sle.
 - 4. Fry Reglet: www.fryreglet.com.
 - 5. Pittcon Industries: www.pittconindustries.com.
 - 6. Structa Wire Corporation: www.structawire.com/#sle.
 - 7. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 FRAMING AND LATH ASSEMBLIES

- A. Provide completed assemblies with the following characteristics:
 - 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. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.
- D. Strip Mesh: Expanded metal lath, same weight as lath, 2 inch wide by 24 inch long; same finish as lath.
- 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, designation G60.
 - 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. Product: #66 Expanded Flange Casing Bead manufactured by Cemco.
 - b. Fabricated of 26 gage hot-dip galvanized steel. Provide beads with expanded metal flange and inverted vee at plaster edge of face flange.
 - 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.
 - 1) Product: No. 2-A Corner Bead manufactured by Cemco.
 - 2) Product: No. 2-A Reinforced Flange Corner Bead manufactured by Cemco.
 - b. 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.
 - 5. Base Screeds: Bevelled edges.
 - a. Foundation Weep Screeds: Perforated type.

- 1) Product: No. 7 Foundation Sill Screed manufactured by Cemco.
 - 2) Product: No. 7 Extended Foundation Screed manufactured by Cemco. For locations where plaster is just above a paving surface.
6. Drip Screeds: Fabricated from 0.018 inch thick; G-90 hot-dip galvanized steel.
 - a. Product: #12 Soffit Drip Edge manufactured by Cemco.
 - b. Product: #6 Head Drip Screed manufactured by Cemco. For locations above other flashing such as door and window heads.
 7. 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.
 8. 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. Product: Soffit Vent PCS-75-V-400 (example for 4 inch size with 3-coat plaster) manufactured by Fry Reglet.
 9. 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.
 10. 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.
 11. Aluminum Accessories (Where Detailed):
 - a. Specified Manufacturer: Fry Reglet Corporation; www.fryreglet.com.
 - b. Acceptable Manufacturers:
 - 1) Interior Specialties Division, Gordon, Inc.; www.gordon-inc.com.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Casing Beads: Fry Reglet, F-shaped aluminum, FPM-75-75, 3/4 inch reveal or Fry J-Molding JPM-75 as detailed.
 - d. Control Joints: Fry Reglet, Channel Screed, PCS-75-50, 1/2 inch wide reveal or as detailed on Drawings.
 - e. 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.
 - f. Aluminum Finish:
 - 1) Clear anodized.
 - g. 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: As specified in 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 Vertical Surfaces:
 - a. Tie Wire: 18 gage.
 - 2. At Horizontal Surfaces:
 - a. Tie Wire: 18 gage, double strand.
- C. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.
 - 1. At Vertical Surfaces:
 - a. Screws: Self-drilling TEKS for metal stud attachment.
 - 2. At Horizontal Surfaces:
 - a. Screws: Self-drilling TEKS for metal stud attachment.
- D. 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. Do not begin until unacceptable conditions have been corrected.
- D. 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 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. Lath shall not be continuous through control or expansion joints.
- C. 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.
- D. 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. Installation shall maintain lath 1/4 inch away from vertical supports.
- E. Attach metal lath to supports using screws at maximum 12 inches on center.
- F. Attach horizontal metal lath to metal supports using tie wire at maximum 6 inches on center vertical.
- G. 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.
- H. Place corner bead with mesh at external wall corners; fasten at outer edges of lath only.
- I. Place strip lath diagonally at corners of lathed openings. Secure rigidly in place.
- J. Place strip lath centered over junctions of dissimilar backing materials on same plane. Secure rigidly in place.
- K. 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.
- L. Place 4 inch wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place.
- M. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.
- N. 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..
- O. 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 05 40 00 - Cold-Formed Metal Framing: Structural metal framing for plaster.
- B. Section 07 25 00 - Weather Barriers: Weather barrier under exterior plaster.
- C. Section 07 62 70 - Exterior Penetration Flashing Panels: Prefabricated flashing sleeves and collars for electrical, mechanical and plumbing items protruding through exterior walls.
- D. Section 08 31 00 - Access Doors and Panels: Access panels.
- E. Section 09 21 16 - Gypsum Board Assemblies: Gypsum Sheathing: Solid backing at all exterior plaster.
- F. Section 09 22 36.23 - Metal Lath: Lath, furring, beads, screeds, and joint accessories for plaster base.
- G. Section 09 91 13 - Exterior Painting: Finish paint over intergral color plaster.

1.03 REFERENCE STANDARDS

- A. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.
- B. ASTM C206 - Standard Specification for Finishing Hydrated Lime; 2014.
- C. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- D. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2016b.
- E. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering; 2006 (Reapproved 2013).
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- G. CBC - California Building Code; 2016.
- H. TSIB (PAM) - Plaster Assemblies Manual, Technical Services Information Bureau; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittals procedures.
- B. Product Data: Provide data on plaster materials and trim accessories.
- C. Evaluation Service Reports: Show compliance with specified requirements.
- D. 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.

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-UP

- A. 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.
- B. 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: Three.
 - 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 2507 Lathing and Plastering, 2511 Interior Plaster, and 2512 Exterior Plaster.
- A. 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 weather resistive barrier as part of the system, by the same manufacturer.
 2. Manufacturer - Basis of Design:
 - a. Parex USA, Inc; Armourwall 300: www.parexusa.com/#sle.
 3. Other Acceptable Manufacturers:
 - a. Omega Products International, Inc.: www.omega-products.com.
 - b. Parex USA, Inc; Armourwall 300: www.parexusa.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Premixed One-Coat Base: Mixture of Type I Portland cement complying with ASTM C150/C150M, hydrated lime complying with ASTM C206 and/or ASTM C207, fibers and other approved ingredients; install in accordance with ASTM C926.
- C. Premixed Base Coats: Mixture of cement, aggregate, fibers, and proprietary admixtures for scratch and brown coats; install in accordance with ASTM C926.
- D. Primer: Acrylic, as recommended by coating manufacturer and compatible with plaster base coat.
- E. Premixed Finish Coating: Integrally colored, acrylic coating.
 1. Color: As indicated on drawings.

2.03 ACCESSORIES

- A. Lath: As specified in Section 09 22 36.23.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 09 22 36.23.
- 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: As specified in Section 07 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify masonry joints are flush and surfaces are ready to receive work of this section, and that there are no existing bituminous or water repellent coatings on masonry surfaces.

- C. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.
- D. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

3.02 PREPARATION

- A. Dampen masonry surfaces to reduce excessive suction.
- B. 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. 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.
 - d. Finish coat to match existing texture.
 - 2. Acrylic Finish Texture: Apply to a consistent finish.
 - a. TSIB (PAM) Fine Sand.
 - b. Parex 534 Sand Fine.

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.
- B. Tile for wall applications.
- C. Tile for stairs.
- D. Cementitious backer board as tile substrate.
- E. Stone thresholds.
- F. Ceramic trim.
- G. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 08 31 00 - Access Doors and Panels: Access panels set in tile surface.
- C. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.
- D. Section 09 24 00 - Cement Plastering: Lath and Portland cement scratch coat, where required by the TCNA (HB) Method specified.
- E. Division 22 - Plumbing: Plumbing Fixtures, Floor drains and miscellaneous devices.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.
 - 1. Use 1999 (Reapproved 2002) as indicated in CBC 2016 Referenced Standards.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- D. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- E. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- F. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- G. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

- H. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- L. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- M. ANSI A108.11> ANSI A108/A118/A136.1 - American National Standard for Interior of Cementitious Backer Units; 2010 (Revised).
- N. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- O. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- P. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar; 2012 (Revised).
- Q. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
- R. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- S. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Revised).
- T. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- U. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- V. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014.
- W. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
 - 1. Use 2012 as indicated in CBC 2016 Referenced Standards.
- X. ANSI/NFSI B101.3 - Test Method for Measuring Wet DCOF of Common Hard Surface Floor Materials; 2012.
- Y. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles; 2014a.
- Z. ASTM C847 - Standard Specification for Metal Lath; 2014a.

- AA. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
- AB. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- AC. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- AD. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; 2002.
- AE. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.
- AF. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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. Provide full size tile samples with grout color selections.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Submit manufacturer's certification that grout materials being provided are suitable for intended use, meet or exceed referenced ANSI standards, and are listed on Ceramic Tile Institute "Tested Materials" list.
 - 2. Prior to shipment of tile to jobsite, deliver Master Grade Certificates to Architect, complying with TCNA/ANSI A137.1.
- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, 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 and TCNA (HB) on site.

- B. 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.
- C. Regulatory Requirements:
 - 1. California Plumbing Code:
 - a. Floor Drains:
 - 1) 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.
 - 2) Surfaces - All surfaces to receive tile work shall be clean, structurally sound, and slopes shall to 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.
 - b. Definition:
 - 1) 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
- D. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- E. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 MOCK-UP

- A. See Section 01 45 00 - Quality Control, 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 the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver tile, cement, lime, mortar and grout to the project site in unopened containers, labeled with the manufacturer's name and brand designation.
 - 2. Grade seal tile cartons by the manufacturer in accordance with ANSI A137.1.

3. Include hallmarks on labels for dry set and latex mortars certifying compliance with ANSI A118.1 and ANSI A118.4 respectively.
- B. Storage: Store tile and cementitious materials in dry, weather tight enclosures. Store stand in a well drained area on a solid surface to prevent mixing with foreign matter.
- C. 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 of 50 degrees F and rising during installation of mortar and grout materials. Temperature of the substrate shall not exceed 100 degrees F.
- C. Shade work from direct sunlight during tile installation as needed to prevent rapid evaporation caused by excessive heat.

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 ten year manufacturer warranty for waterproofing liners.

PART 2 PRODUCTS

2.01 TILE

- A. Acceptable Manufacturers: All products of each type by the same manufacturer.
 1. American Olean Corporation: www.americanolean.com/#sle.
 2. Dal-Tile Corporation: www.daltile.com/#sle.
 3. Other manufacturers as listed on Drawings.
 4. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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: Cushioned.
 5. Surface Finish: Unglazed.
 6. Color(s): To be selected by Architect from manufacturer's standard range.
 7. Trim Units: Matching bullnose, double bullnose, cove base, and cove shapes in sizes coordinated with field tile.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, surface 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.
 - 2. Manufacturers: Same as for tile.
- B. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
- 1. Material and Finish: E - Stainless Steel Type 304 = V2A.
 - 2. Applications:
 - a. Open edges of wall tile.
 - b. Open edges of floor tile.
 - 1) Trim tile to carpet.
 - 2) Product; 5/16-inch AE-80 as manufactured by Schluter; www.schluter.com.
 - c. Wall corners, outside and inside.
 - 1) Description: Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 2) Product; Quadec as manufactured by Schluter; www.schluter.com.
 - d. Transition between floor finishes of different heights.
 - e. Expansion and control joints, floor and wall.
 - f. Floor to wall joints (Cove Base).
 - 1) Description: Profile with integrated trapezoid-perforated anchoring legs, connected at a 90 degree angle by a cove-shaped section with 3/8 inch radius that forms the visible surface.
 - g. Stair Nosing: Brushed stainless steel support with non-slip tread, 2-5/32 inch (55 mm) depth.
 - 1) Fill Color: As selected by Architect.
 - 2) Basis of Design Product: TREP-G-B as manufactured by Schluter, or approved equal.
 - h. Borders and other trim as indicated on drawings.
 - 3. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.
 - b. Genesis APS International: www.genesis-aps.com/#sle.
 - c. Blanke Corp: www.blanke-co.com.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Thresholds: Type and color as indicated on Drawings or as selected by Architect, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
- 1. Applications:
 - a. At doorways where tile terminates.
 - 2. Acceptable Manufacturers/Distributors: See Ceramic Tile Article above.
 - 3. Solid Polymer Fabricated: ASTM D638.
 - a. Color and Pattern: As selected by Architect.
 - b. Manufacturers:

- 1) Formica Corporation Product: Signatures: www.formica.com.
- 2) Avonite Surfaces Product Avonite: www.avonitesurfaces.com.
- 3) Dupont Product: Corian: www.corian.com.
- 4) Panolam Industries International, Inc.(Nevamar); Product Fountainhead: www.nevamar.com.
- 5) Wilsonart International, Inc Product: Gibraltar: www.wilsonart.com.
- 6) Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.03 SETTING MATERIALS

- A. Manufacturers:
 1. Bostik Inc: www.bostik-us.com.
 2. Custom Building Products: www.custombuildingproducts.com.
 3. LATICRETE International, Inc: www.laticrete.com.
 4. Mapei Corporation: www.mapei.com.
 5. Merkrete, by Parex USA, Inc: www.merkrete.com.
 6. TEC, an H.B. Fuller Construction Products Brand: www.tecspecialty.com/#sle.
 7. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3 and TCNA (HB).
 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. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. Dry-Set Portland Cement Mortar Bond Coat: ANSI A118.1 and TCNA (HB), Zero-volatile organic compound (VOC) content..
 1. Products:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- E. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 1. Products:
 - a. Custom Building Products; ProLite Tile & Stone Mortar: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc: www.laticrete.com/#sle.
 - c. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - d. Proflex Products, Inc: www.proflex.us/#sle.
 - e. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.04 GROUTS

- A. Manufacturers:
 - 1. Basis of Design: Custom Building Products: www.custombuildingproducts.com.
 - 2. Custom Building Products: www.custombuildingproducts.com.
 - 3. LATICRETE International, Inc: www.laticrete.com/#sle.
 - 4. MAPEI Corporation: www.mapei.com.
 - 5. Merkrete, by Parex USA, Inc: www.merkrete.com.
 - 6. TEC, an H.B. Fuller Construction Products Brand: www.tecspecialty.com/#sle.
 - 7. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. 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. Bostik Inc: www.bostik-us.com.
 - b. Custom Building Products; Fusion Pro Single Component Grout: www.custombuildingproducts.com.
 - c. LATICRETE International, Inc: www.laticrete.com/#sle.
 - d. Mapei, Inc.; Keracolor S Grout unsanded: www.mapei.com
 - e. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - f. TEC, an H.B. Fuller Construction Products Brand: www.tecspecialty.com/#sle.
 - g. TEC Specialty Construction Brands; Accucolor® Premium Sanded Grout: www.tecspecialty.com.
 - h. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: Toilet Room Floors.
 - 2. Color(s): As indicated on drawings.
 - 3. Products:
 - a. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc: www.laticrete.com/#sle.
 - c. MAPEI Corporation; Kerapoxy Epoxy Grout: www.mapei.com.
 - d. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - e. TEC, an H.B. Fuller Construction Products Brand: www.tecspecialty.com/#sle.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- D. 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 Rooms.

2.05 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: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc: www.laticrete.com/#sle.
 - d. MAPEI Corporation; Mapesil Silicone Sealant: www.mapei.com.
 - e. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - f. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - a. Wall Grout Sealer: Silicone sealer, clear penetrating.
 - b. Floor Grout and Tile Sealer: Acrylic emulsion, 18 percent solids, clear, non-yellowing, slip resistant.
 - 2. Products:
 - a. Specified Manufacturer: Aqua-Mix: www.custombuildingproducts.com; local representative Dale Roberts (951) 255-0243.
 - b. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer: www.merkrete.com/#sle.
 - c. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.06 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Type: Fluid-applied.
 - 2. Thickness: 20 mils, maximum.
 - 3. Crack Resistance: No failure at 1/16 inch gap, minimum.
 - 4. Products:
 - a. Custom Building Products; Custom 9240 Waterproofing and Anti-Fracture Membrane: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc: www.laticrete.com/#sle.
 - c. MAPEI Corporation; Mapelastic HPG w/Fiberglass Mesh: www.mapei.com.
 - d. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - e. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- 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. Fluid or Trowel Applied Type:
 - a. Thickness: 25 mils, minimum, dry film thickness.
 - b. Products:
 - 1) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
 - 2) LATICRETE International, Inc: www.laticrete.com/#sle.
 - 3) Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - 4) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Cleavage Membrane Under Thick Mortar Bed:
 1. Material: No. 15 asphalt saturated felt.
- D. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- E. Membrane at Walls:
 1. Material: No. 15 asphalt saturated felt.
- F. Metal Lath: ASTM C847, Flat diamond mesh, of weight to suit application, galvanized finish.
- G. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 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. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- H. 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 sub-floor 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. Confirm that rough-ins for plumbing, mechanical and electrical work behind tile have been installed and tested.
- C. 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.
- D. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

- E. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
 - 1. Moisture Emission Rate: Not greater than 3 lb per 1000 sq ft per 24 hours, test in accordance with ASTM F1869.
 - 2. Alkalinity (pH): Verify pH range of 5 to 9, test in accordance with ASTM F710.
- F. Verify that required floor-mounted utilities are in correct location.

3.03 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. 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.
- E. 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. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- C. 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.
- D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
 - 1. Joint Pattern: Lay tile in grid pattern unless otherwise indicated on Drawings or directed by Architect. Lay out tile pattern and center tile fields both directions in each space or on each wall area. Provide uniform joint widths.
 - 2. Coordinate with work of Division 22 - Plumbing for access door locations to coincide (at least 2 sides) with tile joints.
- E. Set tile firmly on new; setting bed or backerboard surfaces with a minimum of 100 percent coverage at floors, walls, and toilet/shower areas.
 - 1. Back-butter ribbed tiles and other tiles in accordance with TCNA/ANSI A108.5.
 - 2. Spacers on tile determine joint width between tiles.
 - 3. Strings or pegs may be used to space tile that have no spacers.
 - 4. Bring all surfaces to a true plane at proper position or elevation.
 - 5. Thoroughly beat-in all tile with a beating block while mortar coat is still plastic.
 - 6. Beating shall fill minimum of 95 percent of entire space between units and setting bed.

- 7. Eighty percent coverage of individual tiles is permitted for walls in non-wet areas.
- F. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
 - 1. Prepare surfaces, cut, fit and set tile. Extend tile into recesses and under equipment and fixtures to form a complete covering without interruptions. Terminate tile neatly at obstructions, edges, and corners, without disruption of pattern or joint alignment.
- G. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout. All inside corners shall be coved. No butted 90 degree intersections permitted. All outside corners shall be bull nosed.
- H. Form internal angles square and external angles bullnosed.
- I. Install non-ceramic trim in accordance with manufacturer's instructions.
- J. Install thresholds where indicated.
- K. Sound tile after setting. Replace hollow sounding units.
- L. Keep control and expansion joints free of mortar, grout, and adhesive.
- M. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- N. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- O. 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 - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method with waterproof membrane, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCNA (HB) Method F121.
- B. Cleavage Membrane: Lap edges and ends.
- C. Waterproofing Membrane: Install as recommended by manufacturer .
- D. Mortar Bed Thickness: 1-1/4 inch, unless otherwise indicated.

3.06 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244C, using membrane at toilet rooms.

3.07 GROUTING

- A. Joint Width: As follows unless indicated otherwise on Drawings.
 - 1. Glazed Wall Tile, Unmounted: As determined by spacing lugs.
 - 2. Glazed Floor Tile, Unmounted: 1/8 inch.
 - 3. Porcelain Floor Tile: 1/4 inch.
 - 4. Mounted Tile: As determined by factory-produced spacing.
 - 5. 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.

3.08 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

3.09 GROUT SEALER

- A. Clean grout and apply sealer in accordance with manufacturer's instructions and recommendations.

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 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to inspect waterproofing.
- C. Test shower linings with standing water to the top of the rough threshold for a period of minimum 24 hours. CPC 418.1.
 - 1. A test plug shall be so placed that both the upper and under sides of the lining shall be subjected to test at its point of contact with the sub-drain.
 - a. When the test plug is removed, all of the test water shall drain out by gravity through the weep holes.
 - b. A ring of non-absorbent material must be placed around the weep holes to keep them open when the finish materials are installed.
 - 2. Verify water level has not changed beyond normal evaporation.
 - 3. Inspect floor below and adjacent surfaces for leaks.
- D. Repair or remove and reinstall as required.
- E. Repeat until a satisfactory result is achieved.

3.12 CLEANING

- A. Clean tile and grout surfaces.
 - 1. After completion of setting and grouting, thoroughly clean and polish tile.
 - 2. Do not use acid or acid cleaners to clean tile.
 - 3. When tile is thoroughly clean and dry, polish glazed tile with clean dry cloths.

3.13 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.
- B. Cover floors with kraft paper and protect from dirt and residue from other trades.

- C. Where floor is to be exposed for prolonged periods cover with plywood or other similar type walkways

END OF SECTION

SECTION 09 51 00
SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Specialized architectural ceiling lay-in panels

1.02 RELATED REQUIREMENTS

- A. Section 05 31 00 - Steel Decking: Placement of special anchors or inserts for suspension system.
- B. Section 07 21 00 - Thermal Insulation: Acoustical insulation.
- C. Section 08 31 00 - Access Doors and Panels: Access panels.
- D. Section 21 13 13 - Wet-Pipe Sprinkler Systems: Sprinkler heads in ceiling system.
- E. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) - Air Outlets and Inlets: Air diffusion devices in ceiling.
- F. Division 26 - Electrical - Interior Lighting: Light fixtures in ceiling system.
- G. Division 27 - Communications - Public Address Systems: Speakers in ceiling system.
- H. Section 28 46 20 - Fire Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For; 2014.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- D. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
 - 1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- G. 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; 2014.
- H. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- J. CHPS (HPPD) - High Performance Products Database; Current Edition at www.chps.net/.
- K. DSA Interpretation of Regulations, issued by the Division of the State Architect (DSA).
- L. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- M. UL (FRD) - Fire Resistance Directory; current edition.
- N. UL (GGG) - GREENGUARD Gold Certified Products; current listings at <http://productguide.ulenvironment.com/QuickSearch.aspx>.

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 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
 1. Shop drawings shall show:
 - a. Reflected ceiling plans;
 - b. Location of acoustical ceilings and suspension systems;
 - c. Location of light fixtures, diffusers, speakers and other exposed to view items;
 - d. List of materials;
 - e. Dimensions, jointing, method of hanger attachment, fastenings and other pertinent information.
 - f. Shop drawings may be in the form of revised copies of the Architect's reflected ceiling plan showing any proposed changes from the layout indicated.
- C. Product Data: Provide data on suspension system components.
 1. Submit manufacturer's catalog cuts, specifications, and other data for each component of the acoustical ceiling systems as necessary to demonstrate compliance with these specifications.
 2. Submit copies of the suspension system manufacturer's current ICC Evaluation Service Report.
- D. Samples: Submit two samples 12 by 12 inch in size illustrating material and finish of acoustical units.
- E. Samples: Submit six samples each, 12 inches long, of suspension system main runner.
- F. Manufacturer's Installation Instructions: Indicate special procedures.
- G. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.
 2. Extra Acoustical Units: Five boxes of each type and size. Each box to have a minimum of 10 panels.

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 DELIVERY, STORAGE AND HANDLING

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

1.08 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, or as recommended by the manufacturer for products provided; and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.09 WARRANTY

- A. Warranty Period:
 - 1. Attachment devices (for wall installation): One (1) year from date of substantial completion.
 - 2. Ceiling Panels and Grid: Ten (10) years from date of substantial completion.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Flame Spread Rating: Provide acoustical ceiling units bearing the label of Underwriters' Laboratories, or other testing agency acceptable to the State Fire Marshal, indicating that the units provide the specified flame spread rating.
 - 1. Class A Flame spread rating 0-15, smoke developed 0-15 per ASTM E84 for each acoustical tile type.
- B. 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, Table No. 1607A.1; CBC Title 24 Part 2, Chapter 25.
 - 1. Include the following Interpretation of Regulations, issued by the Division of the State Architect (DSA).
 - a. IR A-5: Acceptance of Products, Materials, and Evaluation Reports; Revised 1/27/17.
 - b. IR 16-9: Pendant Mounted Light Fixtures; Revised 11/3/10.
 - c. IR 25-2.13: Metal Suspension Systems for Lay-In Panel Ceilings; Revised 11/9/17.
 - d. IR 25-1: Maximum Allowable Load for 10 Gage and 12 Gage Wires; Revised 9/23/10.

2.02 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
 - a. Local contacts Dai-Nee Tan 949-275-8169 or Tim Traber 760-473-1108
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.
 - 3. USG: www.usg.com/#sle.
 - 4. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Suspension Systems:
 - 1. Same as for acoustical units.
 - 2. Rockfon, LLC: www.rockfon.com.
 - 3. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

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. Acoustical Panels Type ACP-1: Painted and scored mineral fiber, ASTM E1264 Type III, with the following characteristics:
 - 1. Size: 24 by 48 inches with 24 x 24 inch scored panels.
 - 2. Thickness: 3/4 inches.
 - 3. Composition: Wet felted.
 - 4. Density: 1.09 lb/sq.ft..
 - 5. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
 - 6. NRC Range: 0.65, determined in accordance with ASTM E1264.
 - 7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 8. Fire Rating: Class A
 - a. Flame Spread and Smoke Developed Ratings: 0-25 flame spread and 0-50 smoke developed in accordance with ASTM E84.
 - 9. Edge: Beveled Tegular 9/16 inch.
 - 10. Surface Color: White.
 - 11. Surface Pattern: Non-directional fissured.
 - 12. Suspension System: Exposed grid Type TBAR-1.
 - 13. Basis of Design Product: Cirrus, Second Look II No. 510 as manufactured by Armstrong World Industries, or approved equal.
- C. Acoustical Panels Type ACP-2: Painted and scored mineral fiber, ASTM E1264 Type III, with the following characteristics:
 - 1. Size: 24 by 48 inches with 6 x 48 inch scored panels.

2. Thickness: 3/4 inches.
3. Composition: Wet felted.
4. Density: 1.09 lb/sq.ft..
5. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
6. NRC Range: 0.65, determined in accordance with ASTM E1264.
7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
8. Fire Rating: Class A
 - a. Flame Spread and Smoke Developed Ratings: 0-25 flame spread and 0-50 smoke developed in accordance with ASTM E84.
9. Edge: Beveled Tegular 9/16 inch.
10. Surface Color: White.
11. Surface Pattern: Non-directional fissured.
12. Suspension System: Exposed grid Type TBAR-2.
13. Basis of Design Product: Cirrus, Second Look II No. 511 as manufactured by Armstrong World Industries, or approved equal.

2.04 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
 1. Main runners, cross runners, splices, expansion devices, intersection connectors shall be designed to carry a mean ultimate test load of not less than 180 lbs. in compression and tension per ASTM E580/E580M Section 5.1.2.
- B. Exposed Steel Suspension System Type TBAR-1: Formed steel, commercial quality cold rolled; heavy-duty.
 1. Profile: Tee; 9/16 inch wide face.
 2. Molding: Angle or shadow type, compliant with seismic requirements and as indicated on Drawings.
 3. Construction: Double web.
 4. Recycled Content; 30%, Post-Consumer.
 5. Finish: White painted, unless noted otherwise.
 6. Acceptable products:
 - a. Armstrong; Suprafine XL 7501HRC main runners; FastSize; XL7541 , XL7549, XL7541, and XL7520 cross runners - ICC ESR-1308.
 - b. Chicago Metallic 4000 Tempra Series - ICC-ESR-2631.
 - c. Donn Corp.(USG); DXL26 main runners; DXL-216 cross runners - ICC ESR-1222.

2.05 ACCESSORIES

- A. Accesories are to be compliant with seismic requirements indicated in the ESR approval documents.

- B. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
 - 1. Suspension wires shall be #12 gage (0.106 inch diameter), soft annealed, and galvanized steel wires with Class 1 coating.
- C. Clips:
 - 1. SJCG (Armstrong) – Seismic Joint Clip, 5 inches x 1-1/2 inch, hot-dipped galvanized cold-rolled steel per ASTM A568/A568M. The two piece unit is designed to accommodate a seismic separation joint. The clip is compatible with 15/16 inch and 9/16 inch grid systems including Prelude, Suprafine, and Silhouette. The SJCG is not suitable for use with Vector panel installations.
- D. 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 does not interfere with other work.
- C. Wet operations such as plastering and concrete work shall be completed and dry before installation of acoustical ceilings.
 - 1. Mechanical, electrical and other work above the ceiling line shall be completed and approved before start of acoustical ceiling installation.
- D. Examine surfaces and conditions affecting proper installation of the materials, and report defects in materials or surfaces to which acoustical tile is applied.
 - 1. Do not start work until deficiencies have been corrected.
 - 2. Start of work of this section constitutes acceptance of the surfaces.

3.02 INSTALLATION - GENERAL

- A. Place units as indicated on the shop drawings.
 - 1. Install with joints true and straight and junctures with ceilings, walls and openings neat and tight.
 - 2. Completed work shall present a smooth plane and level surface, free from unevenness, edge or corner offsets, cupping, scratches and other imperfections.
- B. ESR-1308, Section 4.4.3.1, Alternate Seismic Design Category D, E and F Installation: Under this installation, the runners must be rated heavy-duty and have a minimum simple span uniform load of 16.35 pounds per lineal foot (238 N/m); maximum ceiling weight permitted is 4 pounds per square foot (19.5 kg/m²).
- C. The SJCG Seismic Separation Joint Clip is to be installed per the manufacturer's instructions, CS-3815.
- D. Label/mark ceiling panels where valves, dampers, equipment, VAV boxes and similar, are located above.
 - 1. Coordinate with above ceiling trades to provide a label, colored dot, or other demarcation located on the T-bar grid.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636/C 636M, ASTM E 580/E 580M, and manufacturer's instructions and as supplemented in this section.
- 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. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. 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.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. At exterior application of MetalWorks Vector Exterior, provide vertical compression posts of 20 ga. x 2-1/2 inch metal stud at each intersection of suspension grid main runner and cross-bar; 24 inches o.c. each way.
- K. Do not eccentrically load system or induce rotation of runners.
- L. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.04 DSA IR-25-2.13 METAL SUSPENSION SYSTEMS FOR LAY-IN PANEL CEILINGS

- A. General Requirements: CBC Section 1616A1.20 (1616.10.16*) requires the design and installation to be in compliance with ASTM C635/C635M, ASTM C636/C636M, and ASTM E580/E580M, Section 5, with modifications.
 - Note: Amendments in CBC Section 1616A.1.20 (1616.10.16*) replace and append ASCE 7, Section 13.5.6.
 - 1. The requirements in DSA IR 25-2.13 apply to flat and level ceiling systems whose total weight, including ceiling mounted air terminals, services and light fixtures, does not exceed four (4) psf. Heavier systems, systems that are not flat and level, those supporting lateral loads from partitions, and free floating ceilings supported by chains or cables, are beyond the scope of DSA IR 25-2.13 and will be as indicated on Drawings.
- B. Ceiling Design & Installation Requirements:
 - 1. Ceiling System Components:
 - a. Shall comply with ASTM C635/C635M and Section 5.1 of ASTM E580/E580M.
 - b. The ceiling grid system must be rated heavy duty as defined by ASTM C635/C635M.

- c. Main runners, cross runners, splices, expansion devices, and intersection connectors shall be designed to carry a mean ultimate test load of not less than 180 lbs. in compression and tension per ASTM E580/E580M Section 5.1.2.
 - d. Ceiling wire shall be Class 1 zinc coated (galvanized) carbon steel conforming to ASTM A641/A641M. Wire shall be #12 gage (0.106 inch diameter) with soft temper and minimum tensile strength = 70 ksi. The maximum allowable (ASD) tension load for wire meeting this specification is 350 pounds.
 - 1) Four (4) turns of the wire within 1.5 inches will develop the wire allowable load.
 - 2) Three (3) turns of the wire within 3 inches is assumed to develop no more than 50 percent of wire allowable load.
2. Suspension System Installation:
- a. Shall comply with ASTM C636/C636M and Section 5.2 of ASTM E580/E580M.
 - b. #12 gage hanger wires may be used for up to and including a 4 by 4 foot grid spacing and shall be attached to main runners. Splices in hanger wires shall develop 50 percent of the wire allowable load.
 - c. Provide #12 gage hanger wires at the ends of all main and cross runners within eight (8) inches of the support or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area. Perimeter wires are not required when the length of the end tee is eight (8) inches or less.
 - d. Ceiling grid members shall be attached to two (2) adjacent walls per ASTM E580/E580M, Section 5.2.3. Ceiling grid members shall be at least 3/4 inch clear of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.
 - e. The width of the perimeter supporting closure angle shall be not less than two (2) inches. Use of angles with smaller widths in conjunction with proprietary perimeter clips may be acceptable in accordance with Section 5 of DSA IR 25-2.13.
 - f. At the perimeter of the ceiling area, where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal stabilizer or a #16 gage wire with a positive mechanical connection to the runner may be used and placed within eight (8) inches of the wall. Where the perpendicular distance from the wall to the first parallel runner is eight (8) inches or less, the stabilizer or #16 gage wire is not required.
3. Lateral Force Bracing Assembly Installation:
- a. Lateral force bracing assemblies consisting of a compression strut and four (4) #12 gage splayed bracing wires oriented 90 degrees from each other are required for all ceiling areas.
 - 1) Exception: Lateral force bracing may be omitted for suspended acoustical ceiling systems with a ceiling area not to exceed 144 square feet, for all values of SDS, when perimeter support is provided in accordance with subparagraph 3.04 B.2 of this section and perimeter walls are designed to carry the ceiling lateral forces.
 - b. Lateral force bracing assemblies shall be spaced per Table 1 for all values of the component importance factor (Ip) of the ceiling.

- c. There shall be a brace assembly a distance of not more than one half of the above spacing from each surrounding wall, expansion joint and at the edges of any ceiling vertical offset. For example, where the brace spacing is 8 x 12 feet, the edge distance shall be 4 feet in the direction of the 8 foot spacing and 6 feet in the direction of the 12 foot spacing.
- d. The slope of bracing wires shall not exceed 45 degrees from the horizontal plane and wires shall be taut. Splices in bracing wires shall develop the wire allowable load.
- e. Compression struts shall meet the following requirements:
 - 1) The strut shall be sized to adequately resist the vertical component force induced by the ceiling bracing wires and have a maximum kl/r not to exceed 300. The struts listed in Appendix A of DSA IR 25-2.13 meet this requirement for ceilings complying with the general requirements of this referenced IR.
 - 2) The strut shall not be more than one (horizontal) in six (vertical) out of plumb.

TABLE 1: Lateral Force Brace Assembly Spacing

Design Spectral Acceleration Parameter S(DS)	Brace Assembly Spacing (ft.)	
	$z/h \leq 0.5$ *	$z/h \geq 0.5$ * **
S(DS) Less than or equal to 1.15	12 x 12 feet	12 x 12 feet
S(DS) Greater than 1.15 and less than or equal to 1.73	12 x 12 feet	8 x 12 feet
S(DS) Greater than 1.73	8 x 12 feet	8 x 8 feet

*Where, as defined in ASCE 7, Section 13.3.1:

z = height in structure of point of attachment of ceiling with respect to the base.

h = average roof height of the structure with respect to the base.

**It shall be permitted to use the brace assembly spacing for " $z/h > 0.5$ " for the full building height.

- 4. Attachment of Hanger and Bracing Wires:
 - a. Fasten hanger wires with not less than three (3) tight turns in three (3) inches. Hanger wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops (see ASTM E580/E580M, Section 5.2.7.2).
 - b. Fasten bracing wires with not less than four (4) tight turns in 1-1/2 inches.
 - c. Hanger and bracing wire anchorage to the structure shall be installed in such a manner that the direction of the anchorage aligns closely with the direction of the wire. (e.g. bracing wire ceiling clips must be bent as shown in the details and rotated as required to align closely with the direction of the wire, screw eyes in wood must be installed so they align closely with the direction of the wire, etc.).
 - d. Separate all ceiling hanger and bracing wires at least 6 inches from all unbraced ducts, pipes, conduit, etc.
 - e. Hanger and bracing wires shall not attach to or bend around obstructions including but not limited to: piping, ductwork, conduit and equipment. Provide trapeze or other supplementary support members at obstructions to allow typical hanger

- spacing. Brace assemblies must be configured and/or located in order to avoid obstructions in addition to maintaining the required brace assembly spacing.
- f. Provide additional hangers, struts and brace assemblies as required at all ceiling breaks, soffits, or discontinuous areas.
 - g. Hanger wires that are more than one (horizontal) in six (vertical) out of plumb shall have counter-sloping wires.
 - 1) Note: See ASTM C636/C636M, Figure 1, for counter-sloping methods.
 - h. Attachment of the bracing wires to the structure above and to the main runners shall be adequate for the load imposed. The weight (Wp) shall be taken as not less than 4 psf for calculating seismic forces (Fp).
 - i. Post-installed anchors (e.g. expansion anchors, screw anchors and power actuated fasteners) shall have a current Evaluation Report acceptable to DSA in accordance with IR A-5.
 - j. Power-actuated fasteners in concrete are not permitted for bracing wires.
5. Expansion Joints, Seismic Separation Joints:
 - a. Expansion joints shall be provided in the ceiling at intersections of corridors and at junctions of corridors and lobbies or other similar areas.
 - b. For ceiling areas exceeding 2,500 sq. ft., a seismic separation joint shall be provided to divide the ceiling into areas not exceeding 2,500 sq. ft. in accordance with ASTM E580/E580M, Section 5.2.9.
 6. Ceiling Fixtures, Terminals, and Devices:
 - a. All fixtures, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with Section 13.5.6.2.2 Item 5 of ASCE 7 as amended by CBC Section 1616A.1.20 (1616.10.16*) and ASTM E580/E580M Sections 5.3 and 5.4.
 - b. Ceiling panels shall not support any light fixtures, air terminals or devices.
 - c. Penetrations through the ceiling for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a 2 inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of 1 inch in all horizontal directions. Alternatively, per ASTM E580/E580M, Section 5.2.8.5, a flexible sprinkler hose fitting that can accommodate 1 inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve, or adapter.
 - d. Slack safety wires shall be considered hanger wires for installation and testing requirements.
 - e. Light Fixtures:
 - 1) All light fixtures shall be positively attached to the ceiling suspension systems by mechanical means per CEC Article 410.36 to resist a horizontal force equal to the weight of the fixture. A minimum of two screws or approved fasteners are required at each light fixture, per ASTM E580/E580M, Section 5.3.1.
 - 2) Surface-mounted light fixtures shall be attached to the main runner with at least two positive clamping devices on each fixture. The clamping device shall completely surround the supporting ceiling runner and be made of steel with a minimum thickness of #14 gage. Rotational spring catches do not comply. A #12 gage slack safety wire shall be connected from each clamping device to the

structure above. Provide additional supports when light fixtures are 8 feet or longer or exceed 56 lbs. Maximum spacing between supports shall not exceed 8 feet.

- 3) Light fixtures weighing less than or equal to 10 lbs. shall have a minimum of one (1) #12 gage slack safety wire connected from the fixture housing to the structure above.
 - 4) Light fixtures weighing greater than 10 lbs. but less than or equal to 56 lbs may be supported directly on the ceiling runners, but they shall have a minimum of two (2) #12 gage slack safety wires connected from the fixture housing at diagonal corners to the structure above.
 - (a) Exception: All light fixtures greater than 2 by 4 feet weighing less than 56 lbs. shall have a #12 gage slack safety wire at each corner.
 - 5) All Light fixtures weighing greater than 56 lbs. shall be independently supported by not less than four (4) taut #12 gage hanger wires (one at each corner) attached from the fixture housing to the structure above or other approved hangers. The four (4) taut #12 gage wires or other approved hangers, including their attachment to the structure above, shall be capable of supporting four (4) times the weight of the fixture.
- f. Services within the Ceiling:
- 1) All flexible sprinkler hose fitting mounting brackets, ceiling-mounted air terminals or other services shall be positively attached to the ceiling suspension systems by mechanical means to resist a horizontal force equal to the weight of the component. Screws or approved fasteners are required. A minimum of two attachments are required at each component.
 - 2) Ceiling-mounted air terminals or other services weighing less than or equal to 20 lbs. shall have one (1) #12 gage slack safety wire attached from the terminal or service to the structure above.
 - 3) Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing more than 20 lbs. but less than or equal to 56 lbs. shall have two (2) #12 gage slack safety wires (at diagonal corners) connected from the terminal or service to the structure above.
 - 4) Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing more than 56 lbs. shall be supported directly from the structure above by not less than four (4) taut #12 gage hanger wires attached from the terminal or service to the structure above or other approved hangers. The four (4) taut #12 gage wires or other approved hangers, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.
- g. Other Devices within the Ceiling:
- 1) All lightweight miscellaneous devices, such as strobe lights, occupancy sensors, speakers, exit signs, etc., shall be attached to the ceiling grid per subparagraph 3.04 B.6.f.1 of this Section. In addition, devices weighing more than 10 lbs. shall have a #12 gage slack safety wire anchored to the structure above per subparagraph 3.04 B.6.f.2 of this Section. Devices weighing more than 20 lbs. shall be supported from the structure above using details provided by the registered design professional (RDP).

C. Additional Requirements:

1. Pendant Mounted Light Fixtures:
 - a. Where pendant mounted light fixtures are to be installed in areas with a suspended ceiling, the construction documents shall include complete support details complying with DSA IR 25-2.13 and DSA IR 16-9.
 - b. Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two (2) times the weight of the fixture.
 - c. If a pendant mounted light fixture is directly and independently braced below the ceiling (i.e., aircraft cables to walls), then a brace assembly is not required above the ceiling.
 - d. If a pendant mounted light fixture is free to swing 45 degrees from vertical in all directions, and is not directly and independently braced below the ceiling, then a bracing assembly is only required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit the horizontal and vertical forces. Exception: Where the weight of the fixture is less than 20 lbs., the vertical component of the brace force need not be considered so no compression strut/post is required.
 - e. Rigid conduit shall not be used for attachment of the fixtures.
2. Acoustical Ceiling Tile Panel Installation
 - a. For ceiling installations utilizing acoustical tile panels of mineral or glass fiber, it is not mandatory to provide 3/4 inch clearance between the acoustical tile panels and the wall on the sides of the ceiling which are free to slip.
3. Other Panel Types:
 - a. Panels weighing more than 1/2 psf, other than mineral fiber and glass fiber acoustical tile, and all metal and wood panels shall be positively attached to the ceiling suspension runners by mechanical means, such as bolts, screws, or rivets, and each attachment shall have the allowable design strength to support 100 percent of the weight of the panel acting in any direction. A minimum of two attachments are required for each panel. For ceiling installations utilizing panels other than mineral or glass fiber, 3/4 inch clearance shall be provided between the ceiling panel and the wall on the sides of the ceiling area which are free to slip, unless otherwise justified by seismic qualification indicated below.
 - b. The use of other types of attachment, such as clips, snap-in devices, perforated lips, clamping devices, or spring loaded devices or hooks, shall be listed per DSA IR A-5 and identified for use with the type of ceiling framing members and panels. The listing shall be seismically qualified in accordance with ASCE 7 Section 13.2.5 or 13.2.6.
 - c. An alternate means of compliance per CAC 4-304 may be proposed and reviewed on a project by project basis when using unlisted means of attachment. The alternate means of attachment shall have the allowable design strength to support 100 percent of the weight of the panel acting in any direction and shall be capable of maintaining that strength if the ceiling grid is distorted or out of level.
 - d. It is also alternately permitted to provide a secondary means of connecting the panel to the grid or structure to retain the panel in case of panel dropout, ceiling grid distortion, and ceiling grid becoming out-of-level. The secondary attachment

shall have the allowable design strength to support two (2) times the weight of the panel acting in any direction, such as a slack wire or cable.

- e. Special attachment details complying with one of the methods outlined above, such as screws or cables, shall be provided at the perimeter of the ceiling, where panels are cut or altered, or where non-standard panel sizes or edge conditions occur.
4. Exitways:
- a. Exitways of essential services buildings shall be installed in accordance with Section 13.5.6.2.2 Item 1 of ASCE 7 as amended by CBC Section 1616A.1.20 (1616.10.16*). A main or cross runner shall be installed on all sides of each piece of tile, board or panel and each light fixture or grill. Splices or intersection of such runners shall be attached with through connectors such as pop rivets, screws, pins, plates with end tabs or other approved connectors.
5. Free Floating Ceilings:
- a. Free floating ceilings (ceilings not attached to any walls) supported by wires in accordance with DSA IR 25-2.13 shall be braced in accordance with this referenced IR, regardless of the ceiling area, unless it can be demonstrated the anticipated ceiling movement will not cause failure of the ceiling components or failure of mechanical, electrical, plumbing, and fire and life safety components/systems within the ceiling area and within the area of anticipated movement.
 - b. The perimeter of free floating ceilings shall be supported by a continuous runner which is spliced in accordance with ASTM E580/E580M Section 5.1.2.
- D. Ceiling System Alteration: The entire ceiling in the affected space shall be upgraded to meet the current requirements of the CBC and DSA IR 25-2.13, if any portion of the grid system is cut or altered.
- 1. Where the ceiling grid is not cut or altered, and the scope of work includes only the following:
 - a. Replacement of existing ceiling panels with like panels of equal or lesser weight.
 - b. Replacement of light fixtures and/or terminals with like units (units of equal size and of equal or lesser weight) placed in the same location.
 - c. No upgrade to the ceiling grid, suspension system or lateral force brace assemblies is required.
 - 2. Re-Use of Existing Ceiling Hanger Wires and Bracing Wires: Existing ceiling hanger and bracing wires may be reused provided they comply with the following:
 - a. The gage and spacing of the wires must comply with the current applicable codes and DSA IR 25-2.13.
 - b. If a new wire is to be spliced to an existing wire, the architect or structural engineer in general responsible charge must submit to the DSA for approval a detail and specification describing how the splice is to be made. Acceptable wire splice details are provided in Appendix A.
 - c. See Section 7 for testing requirements for the re-use of existing hanger and bracing wire assemblies.
- E. DSA Acceptance of Evaluation Reports:
- 1. Ceiling grid systems or components, with valid evaluation reports issued by qualified evaluation agencies, in accordance with DSA IR A-5, are accepted by the DSA, provided

the system or component meets the requirements of CBC Section 1616A.1.20 (1616.10.16*), ASTM C635/C635M, ASTM C636/C636M and ASTM E580/E580M. Where a qualified evaluation report is utilized, the installation shall comply with all the requirements specified in the evaluation report, i.e., connections, member sizes, perimeter details, special clips to wall angles, etc.

2. In accordance with DSA IR A-5, DSA will accept OSHPD Preapproved Details (OPD) "2013 CBC Standard Suspended Ceiling Details for Acoustical Tile or Lay-in Panel Ceilings."

3.05 INSTALLATION - ACOUSTICAL UNITS

- A. Install in coordination with suspension system.
- B. Install acoustical units in accordance with manufacturer's instructions.
- C. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
 1. Perform all cutting required for fixtures, pipes and other work passing through acoustical tile and panels.
 - a. Neatly and tightly fit units to such work and adjoining work.
 - b. Fit border units neatly and tightly against abutting surfaces.
 2. Scribe and cut panels to fit accurately at borders and at penetrations.
 3. Cut to fit irregular grid and perimeter edge trim.
 4. Make field cut edges of same profile as factory edges.
 5. Double cut and field paint exposed reveal edges.
 6. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
 7. Edges shall be concealed by support of suspension members.
- H. Install hold-down clips on panels within 20 ft of an exterior door.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, 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 25-2.13): 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.
2. Re-Use of Existing Ceiling Hanger Wires and Bracing Wires:
 - a. All existing ceiling hanger wire/anchor assemblies must be tested to 200 lbs.
 - b. All existing bracing wire/anchor assemblies must be field tested to 440 lbs.
 - c. Where a new wire is spliced to an existing wire, each spliced wire/anchor assembly must be field tested to the loads given for existing assemblies above.

3.07 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.

3.08 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 sheet flooring.
- B. Resilient base.
- C. Resilient stair accessories.
- D. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.
- D. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- E. Division 26 - Electrical: Connection of grounding strips to building structure or ground bus.

1.03 REFERENCE STANDARDS

- A. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine; 2009.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
 - 1. Use 2004 as indicated in 2016 CBC Referenced Standards.
- C. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2003 (Reapproved 2016).
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- E. ASTM F2034 - Standard Specification for Sheet Linoleum Floor Covering; 2008 (Reapproved 2013).
- F. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.
- H. RFI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Verification Samples: Submit two samples, 2 by 2 inch in size illustrating color and pattern for each resilient flooring product specified.
- E. Concrete Testing Standard: Submit a copy of ASTM F710.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.
 - 2. Extra Flooring Material: 100 square feet of each type and color.
 - 3. 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.

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 Accessibility Guidelines for Buildings and Facilities, latest amendment.
 - 1. Flooring surface shall be stable, firm, and slip resistant. CBC Section 11B-302.1 General.

2. Flooring surface shall demonstrate a dynamic coefficient of friction of at least 0.42 per DCOF AcuTest ANSI 137.1 Section 9.6 and ANSI 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 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 SHEET FLOORING

- A. Linoleum Sheet Flooring - Type LF-1, LF-2, & LF-3: Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness.
 1. Basis of Design Product: Harmonium Veneto as manufactured by Johnsonite, or approved equal.
 2. Manufacturers:
 - a. Armstrong World Industries, Inc: www.armstrong.com/#sle.
 - b. Forbo Flooring, Inc: www.forboflooringna.com/#sle.
 - c. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 - d. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 3. Minimum Requirements: Comply with ASTM F2034, Type corresponding to type specified.
 4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 5. VOC Content Limits: As specified in CalGreen.
 6. Backing: Jute fabric.
 7. Thickness: 0.100 inch, minimum, excluding backing.
 8. Sheet Width: 78 inch, minimum.
 9. Color: As indicated on drawings.
- B. Feature Strips: Of same material as sheet flooring, 4 inch wide.
- C. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.03 STAIR COVERING

- A. RTS-1 Basis of Design Product: Microtone as manufactured by Johnsonite, a Tarkett Company, or approved equal.
- B. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness.
 - 1. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 3. Nominal Thickness: 0.1875 inch.
 - 4. Nosing: Square.
 - 5. Striping: 2 inch wide contrasting color abrasive strips.
 - 6. Texture: Smooth.
 - 7. Color: As indicated on drawings.
- C. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
 - 1. Thickness: 0.080 inch.
- D. Stair Stringers: Full height in one piece and in maximum available lengths, matching treads in material and color.
 - 1. Nominal Thickness: 0.080 inch.
- E. Stair Nosings: 1-1/2 inch horizontal return, 1-1/8 inch vertical return, full width of stair tread in one piece.
 - 1. Material: Rubber.
 - 2. Nominal Thickness: 0.125 inch.
 - 3. Striping: 2 inch wide contrasting color abrasive strips.
 - 4. Texture: Smooth.
 - 5. Color: To match stair treads.

2.04 RESILIENT BASE

- A. RB-1 Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Basis of Design Product: Traditional Wall Base as manufactured by Johnsonite, or approved equal.
 - 2. Critical Radiant Flux (CRF): Minimum 0.22 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 3. Height: 6 inch.
 - 4. Thickness: 0.125 inch.
 - 5. Finish: Satin.
 - 6. Length: Roll.
 - 7. Color: As indicated on drawings.

8. Accessories: Premolded external corners and internal corners.

2.05 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Filler for Coved Base: Plastic.
- E. Sound Control Underlayment: Recycled rubber type.
 1. Manufacturers:
 - a. U.S. Rubber Recycling, Inc; Quietsound Acoustical Underlayment: www.usrubber.com/#sle.
 - b. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 2. Roll Thickness: 1/8 inch, nominal.
 3. Roll Width: 48 inch.
 4. Sound Reduction: Test in accordance with ASTM E492 and ASTM E2179.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Test in accordance with Section 09 05 61.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- C. Environmental Condition: Comply with flooring manufacturer's instructions and recommendations.
 1. Verify that ambient and surface temperatures and humidity conditions are in compliance.
- D. Verify that required floor-mounted utilities are in correct location.
- E. 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. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

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.
 - 2. Fit joints and butt seams tightly.
 - 3. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Install flooring in recessed floor access covers, maintaining floor pattern.
- H. At movable partitions, install flooring under partitions without interrupting floor pattern.

3.04 INSTALLATION - SOUND CONTROL UNDERLAYMENT

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

3.05 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seams are prohibited in kitchens, toilet rooms, and custodial closets.
- C. Cut sheet at seams in accordance with manufacturer's instructions.
- D. Seal seams by heat welding.
- E. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.06 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.

3.07 INSTALLATION - STAIR COVERINGS

- A. Install stair coverings in one piece for full width and depth of tread.
- B. Install stringers configured tightly to stair profile.
- C. Adhere over entire surface. Fit accurately and securely.

3.08 FIELD QUALITY REQUIREMENTS

- A. Manufacturer's Field Services: Upon District's request and with at least 72 hours notice, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.09 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.
- C. Installation Clean-Up: Upon completion of installation in a room or area, clean flooring and adjacent surfaces.
 - 1. Sweep or vacuum floor thoroughly.
 - 2. Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.
 - 3. Remove excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturers.
- D. Initial Cleaning: After adhesive has set but no sooner than 5 days after installation, wash resilient tile flooring with a neutral type cleaning solution in accordance with manufacturer's instructions and recommendations. Rinse thoroughly with clear, cool water but do not flood floor.
 - 1. After completion of installation, apply one coat of polish, if recommended by manufacturer, and buff to even luster.
 - 2. After final cleaning, apply second coat of polish as recommended by tile manufacturer and buff to even luster.
- E. Final Cleaning: Thoroughly clean resilient tile flooring and accessories in accordance with final cleaning specified in Section 01 77 00 - Closeout Procedures.
 - 1. Clean resilient flooring not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of Project.

2. Clean resilient flooring by method recommended by resilient flooring manufacturer, including stripping and application of additional floor polish and buffing to even luster.

3.10 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. From the time of laying until Acceptance, protect flooring from damage.
 1. Lay reinforced kraft paper runners and provide barricades and signs as necessary to prevent construction traffic on completed installations.
 2. Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishings across floors.
 3. Remove and replace defects which develop such as damaged, loose or broken tile and resilient accessories.

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.
- C. Section 09 6500 - Resilient Flooring: Topset Base.

1.03 REFERENCE STANDARDS

- A. AATCC Test Method 134 - Electrostatic Propensity of Carpets; 2011.
- B. AATCC Test Method 16 - Test Method for Colorfastness to Light; 2004.
- C. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.
- D. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- E. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- F. CRI (GLP) - Green Label Plus Testing Program - Certified Products; www.carpet-rug.org; current edition.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, 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.scscertified.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. Basis of Design: Interface, Inc: www.interfaceinc.com, or approved equal.
 2. Lees Carpets: www.leescarpets.com.
 3. Milliken & Company: www.milliken.com.
 4. Tandus: www.tandus.com.
 5. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.03 MATERIALS

- A. Tile Carpeting: Tufted, Textured Loop, manufactured in one color dye lot.
 1. Product: ISO #04536 manufactured by Tandus Centiva.
 2. Tile Size: 19 by 36 inch, nominal.
 3. Thickness: 0.35 inch, nominal.
 4. Color: 48201 Wired.
 5. Pattern: Geometric.
 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: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 9. Indoor Air Quality—CRI Green Label Plus™
 10. Antimicrobial: None.
 11. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity, AATCC Test Method 134.
 12. Gage: 5/64 inch.
 13. Stitches: 10.0 per inch.
 14. Light Fastness: >= 4.0 at 80 Hours, AATCC Test Method 16.
- B. Tile Carpeting: Tufted, Textured Loop, manufactured in one color dye lot.

1. Product: Detours manufactured by Interface.
2. Tile Size: 19.7 by 19.7 inch, nominal.
3. Thickness: 0.35 inch, nominal.
4. Color: 104717 Onyx.
5. Pattern: Geometric.
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: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
9. Indoor Air Quality—CRI Green Label Plus™
10. Antimicrobial: None.
11. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity, AATCC Test Method 134.
12. Gage: 1/12 inch.
13. Stitches: 8 per inch.
14. Light Fastness: ≥ 4.0 at 80 Hours, AATCC Test Method 16.

2.04 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
 1. Reducer, CRS-29-A manufactured by Johnsonite, a Tarkett Company; www.johnsonite.com; or approved equivalent product.
- C. Adhesives:
 1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor 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 sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and 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.
- 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 sub-floor 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 Owner and in accordance with cleaning specified in Section 01 70 00 - Execution and Closeout Requirements.

END OF SECTION

SECTION 09 84 30
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing panels.
- B. Mounting accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2009a.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
 - 1. Coordination Drawings: Project-specific Coordination Drawings, indicating the following items drawn and coordinated with each other. Include information required by Installers of each item in order to coordinate the Work. Include the following:
 - a. Relationship of items shown on separate Shop Drawings.
 - b. Dimensions and required clearances of adjacent or related work.
 - c. Order of assembly of separate items.
 - d. Information required for interface with other trades and components, including mechanical, electrical, and communication work required for, integrated with, or adjacent to, acoustic panels work.
- D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
- E. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.
- F. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
- G. Manufacturer's Qualification Statement.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.

2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

1.07 MOCK-UP

- A. See Section 01 45 00 - Quality Control, for additional mock-up requirements.
- B. Construct mock-up of acoustical units at location as indicated by Architect.
 1. Minimum mock-up dimensions; 96 by 96 inches.
 2. Approved mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Ambient Conditions: Do not install acoustic panels until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete.
- B. Ambient Conditions: Maintain ambient temperature and humidity conditions at the levels indicated for Project when occupied for its intended use during and after installation of acoustic panels.

1.09 WARRANTY

- A. Manufacturer's written warranty indicating manufacturer's intent to repair or replace acoustical absorber and diffuser panels that fail in materials or workmanship within 3 years from date of Substantial Completion. Failures are defined to include, but are not limited to, the following:
 1. Fracturing or breaking of unit components which results from normal wear and tear and normal use other than vandalism.
 2. Delamination or other failures of glue bond of components.
 3. Warping of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
 4. Failure of unit to perform acoustically in accordance with manufacturer's published data.
- B. Warranties: Provide owner with a (1) year warranty for material and workmanship on all installed products.
 1. Manufacturers: All materials, wood panel and grid, shall be warranted for (1) one year for material and workmanship.
 2. Installer: All work shall be warranted for (1) year from final acceptance of completed work.

PART 2 PRODUCTS

2.01 WOOD VENEER SOUND-ABSORBING UNITS

- A. Manufacturers: Or approved equal.
 - 1. decoustics, division of Certainteed: Quadrillo Wood Panel: www.decoustics.com.
 - 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Wood Veneer Acoustical Panels for Walls and Ceilings: Medium Density Fiberboard (MDF) core panels with prime grade finished face veneer and non-woven acoustic material adhered to back of panel.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. Noise Reduction Coefficient (NRC): 0.70 to 0.80 when tested in accordance with ASTM C423 for Type F5 mounting, per ASTM E795.
 - 3. Acoustic Back-Up Material: Compressed fiberglass board, 6-7 lbs/cu ft density, in sizes to fit furring applications.
 - a. Thickness: 1-3/8 inch.
 - 4. Provide MDF with no added urea formaldehyde (NAUF).
 - 5. Panel Weight: 3.50 psf.
 - 6. WP-1 Surface Veneer Species: Oak.
 - a. Grain Direction: Flat.
 - b. Factory Finish: Clear sealer.
 - 7. WP-2 Surface Veneer Species: Walnut.
 - a. Grain Direction: Flat.
 - b. Factory Finish: Clear sealer.

2.02 FABRICATION

- A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
 - 1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
- B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.
- C. Factory-applied finishes on wood veneer panels to be uniform, smooth, and without blemishes.

2.03 ACCESSORIES

- A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
 - 1. Two-part clip and base-support bracket system; brackets designed to support full weight of panels and clips designed for lateral support, with one part mechanically attached to back of panel and the other attached to substrate.

- B. Trim Moldings: Manufacturer's standard wood or vinyl trim moldings for concealing panel joints; color as selected from manufacturer's standards.
- C. Fixing Clips: Manufacturers standard for application as indicated.
- D. Furring Strips: 1 by 2 inch wood furring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify blocking, anchorages, and structural supports are in place and adequate to received work.
- C. Verify HVAC and electrical rough-in components are properly located.

3.02 PREPARATION

- A. Coordinate requirements for blocking required in frame construction to receive acoustic panels.
- B. Coordinate installation of acoustic panels to ensure proper installation and operation of each component and, where applicable, to meet acoustic design requirements of rehearsal and performance spaces containing acoustic panels.
 - 1. Sequencing and scheduling of acoustic panels installation with completion of related and adjacent work.
 - 2. Preparation of openings to receive acoustic panels.
 - 3. Placement of blocking, anchorages, and structural supports required for acoustic panels.
 - 4. Installation of HVAC and electrical rough-in components for connection to acoustic panels.
 - 5. Preparation of Project Record Documents for acoustic panels.
 - 6. Coordinate preparation of operation and maintenance manuals for acoustic panels.
 - 7. Coordinate demonstration and training activities for acoustic panels.

3.03 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- C. Install wall-mounted acoustical panels utilizing corner mounting z-brackets or grooved buttons and concealed wall brackets. Where indicated, secure units to wall with fasteners along top of unit.
- D. Do not modify panels in the field.
- E. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
 - 1. Plumb and level.

2. Flatness.
3. Width of joints.

3.04 FIELD QUALITY CONTROL

- A. Should completed installation fail to meet requirements, Contractor shall make modifications necessary to correct performance and retest room as directed by Architect to indicate compliance, at Contractor's expense.

3.05 CLEANING

- A. Repair or replace visual/performance defective work as directed by Architect upon inspection.
- B. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.
- C. Clean unit surfaces. Touch up, refinish, or replace damaged components in a manner acceptable to Architect.

3.06 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

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.
- 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. Brick, Glass unit masonry, Architectural concrete, and Cast stone.
 - 9. Glass.
 - 10. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- B. Section 05 51 00 - Metal Stairs: Shop-primed items.
- C. Section 09 91 23 - Interior Painting.
- D. Section 09 96 00 - High-Performance Coatings: Exterior doors and metal surfaces.
- E. Section 32 17 13 - Pavement Markings: Painted pavement markings.

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 - Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing; 1985.

- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- D. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.
- E. SSPC-SP 1 - Solvent Cleaning; 2015.
- F. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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 definitely not required.
 - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8 by 10 inch in size.
- E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.
- G. 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.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, 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 and approved by manufacturer.

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 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. 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. Paints:
 1. Behr Process Corporation: www.behr.com/#sle.
 - a. Local representative Jan Piccola 714.679.5730.
 2. Dunn-Edwards Corporation: www.dunnedwards.com,
 - a. Local representative Wanda Barragan 909.261.1289.
 3. PPG Paints: www.ppgpaints.com/#sle.

4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - a. Local representative John Dumesnil 619.665.9341.
5. Vista Paint: www.vistapaint.com.
 - a. Local representative Mark Brower 323.397.9000.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

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 specifically described in manufacturer's product instructions.
- B. 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.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.
 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

- A. See Appendix A at the end of this section.

- B. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including cement board 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.
- C. Paint GE-OP-3L - Exterior Plaster, Opaque, 100% Acrylic Latex, 3 Coat:
- D. Paint ME-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
 - 1. See Section 09 96 00 - High-Performance Coatings.
- E. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 - 1. See Section 09 96 00 - High-Performance Coatings.
- F. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
 - 1. See Section 09 96 00 - High-Performance Coatings.
- G. Paint MgE-OP-3LA-HP - Ferrous Metals, Unprimed, High-Performance, 3 Coat:
 - 1. See Section 09 96 00 - High-Performance Coatings.

2.04 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 effect 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 Plaster and Stucco: 12 percent.

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. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- H. Galvanized Surfaces:
 - 1. 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 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. 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.
- 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.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- G. Sand 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 45 00 - Quality Control, 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.

3.07 SCHEDULE - PAINT SYSTEMS

- A. Concrete, Concrete Masonry Units (CMU), Concrete Block, Brick Masonry: Finish surfaces exposed to view.
 - 1. Exterior: CE-OP-3A, flat.
- B. Exterior Plaster: Finish surfaces exposed to view.
 - 1. Exterior Soffits: GE-OP-2L, flat.
 - 2. Exterior Walls (Exterior Plaster and Stucco): GE-OP-3L.
- C. Steel Fabrications: Finish surfaces exposed to view.
 - 1. Exterior: ME-OP-3LA-HP, semi-gloss; finish all surfaces, including concealed surfaces, before installation.
 - 2. Exterior AESS, exterior steel, metal canopies, exposed steel decks, hollow metal doors and frames, metal stair stringers and treads, guardrails/handrails, metal copings/flashings, and equipment screens,
- D. Galvanized Steel: Finish surfaces exposed to view.
 - 1. Exterior: Paint MgE-OP-3L, gloss.
- E. Shop-Primed Metal Items: Finish surfaces exposed to view.
 - 1. Finish the following items:
 - a. Exposed surfaces of lintels.
 - b. Elevator pit ladders.
 - c. Exposed surfaces of steel stairs and railings, if noted as painted.
 - 2. Exterior: Paint-ME-OP-2A, semi-gloss.

END OF SECTION

EXTERIOR PAINT SCHEDULE:

1. Stucco, Cement Plaster

Flat – **Professional** Exterior 100% Acrylic

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Multi-Surface Primer 436	Loxon Concrete Primer A24W8300	Eff-Stop Premium ESPR00
Intermediate Coat:	Behr Pro e600 Exterior Flat 610	A-100 Exterior Flat A6-100 Series	Spartashield Flat SSSL10
Topcoat:	Behr Pro e600 Exterior Flat 610	A-100 Exterior Flat A6-100 Series	Spartashield Flat SSSL10

2. Steel, Ferrous Metal

Satin – **Professional** Exterior 100% Acrylic

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Multi-Surface Primer 436	Pro-Cryl Universal Primer B66W1310	Bloc Rust Premium BRPR00 2WH
Intermediate Coat:	Behr Pro e600 Exterior Satin 640	A-100 Exterior Satin A82-100	Spartashield Low Sheen SSSL40
Topcoat:	Behr Pro e600 Exterior Satin 640	A-100 Exterior Satin A82-100	Spartashield Low Sheen SSSL40

Semi-Gloss – **Professional** Exterior 100% Acrylic

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Multi-Surface Primer 436	Pro-Cryl Universal Primer B66W1310	Bloc Rust Premium BRPR00 2WH
Intermediate Coat:	Behr Pro e600 Ext. Semi-Gloss 670	Solo Semi-Gloss 76 Series	Spartashield Semi-Gloss SSSL50
Topcoat:	Behr Pro e600 Ext. Semi-Gloss 670	Solo Semi-Gloss 76 Series	Spartashield Semi-Gloss SSSL50

3. Steel, Ferrous Metal – High Performance, Industrial Maintenance

Gloss, 100% Acrylic, Direct-To-Metal Enamel

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Multi-Surface Primer 436	Pro-Cryl Universal Primer B66W1310	Bloc Rust Premium BRPR00 2WH
Intermediate Coat:	Direct To Metal Gloss 8200	Pro Industrial DTM Gloss B66W01051	Endura-Coat Gloss ENCT60
Topcoat:	Direct To Metal Gloss 8200	Pro Industrial DTM Gloss B66W01051	Endura-Coat Gloss ENCT60

4. Galvanized Metal, Aluminum, and Non-Ferrous Metals

Semi-Gloss – **Professional** Exterior 100% Acrylic

	Behr	Sherwin-Williams	Dunn-Edwards
Pretreatment:	Klean Strip Prep & Etch (GKA30220)	Krud Kutter Metal Clean & Etch	Krud Kutter Metal Clean & Etch

Prime Coat:	Premium Multi-Surface Primer 436	Pro-Cryl Universal Primer B66W1310	Ultra-Grip Premium UGPR00
Intermediate Coat:	Behr Pro e600 Ext. Semi-Gloss 670	Solo Semi-Gloss 76 Series	Spartashield Semi-Gloss SSSL50
Topcoat:	Behr Pro e600 Ext. Semi-Gloss 670	Solo Semi-Gloss 76 Series	Spartashield Semi-Gloss SSSL50

5. Galvanized Metal, Aluminum, Non-Ferrous Metals – High Performance, Industrial Maintenance

Gloss, 100% Acrylic, Direct-To-Metal Enamel

	Behr	Sherwin-Williams	Dunn-Edwards
Pretreatment:	Klean Strip Prep & Etch (GKA30220)	Krud Kutter Metal Clean & Etch	Krud Kutter Metal Clean & Etch
Prime Coat:	Premium Multi-Surface Primer 436	Pro-Cryl Universal Primer B66W1310	Ultra-Grip Premium UGPR00
Intermediate Coat:	Direct To Metal Gloss 8200	Pro Industrial DTM Gloss B66W01051	Endura-Coat Gloss ENCT60
Topcoat:	Direct To Metal Gloss 8200	Pro Industrial DTM Gloss B66W01051	Endura-Coat Gloss ENCT60

END OF SCHEDULE APPENDIX

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. Elevator pit ladders.
 - 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.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers, grilles, to match face panels.
- 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 05 50 00 - Metal Fabrications: Shop-primed items.
- B. Section 05 51 00 - Metal Stairs: Shop-primed items.
- C. Section 09 91 13 - Exterior Painting.
- D. Section 09 96 00 - High-Performance Coatings.
- E. Section 32 17 13 - Pavement Markings: Painted pavement markings.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing; 1985.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2015.
- C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- E. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.
- F. SSPC-SP 1 - Solvent Cleaning; 2015.
- G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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 definitely not required.
 - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
 - 4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as factory finished metals, wood cabinets, and wood doors, have been approved.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on aluminum sheet, 8 x 10 inch in size.
- E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.

- G. 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.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, 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.

1.05 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 and approved by manufacturer.

1.06 MOCK-UP

- A. See Section 01 45 00 - Quality Control, for general requirements for mock-up.
- B. Provide panel, 9 feet high by 12 feet wide, illustrating paint color, texture, and finish.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

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 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. 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. Paints:
 - 1. Behr Process Corporation: www.behr.com/#sle.
 - a. Local representative Jan Piccola (714) 679-5730.
 - 2. Dunn-Edwards Corporation: www.dunnedwards.com,
 - a. Local representative Wanda Barragan (909) 261-1289.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - a. Local representative John Dumesnil (619) 665-9341.
 - 4. Vista Paint; www.vistapaint.com .
 - a. Local representative Mark Brower (323) 397-9000.
- C. Transparent Finishes:
 - 1. Behr Process Corporation: www.behr.com/#sle.
 - 2. PPG Paints Deft Interior Clears/Polyurethanes: www.ppgpaints.com/#sle.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- D. Stains:
 - 1. Behr Process Corporation: www.behr.com/#sle.
 - 2. PPG Paints Deft Interior Stains: www.ppgpaints.com/#sle.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- E. Primer Sealers: Same manufacturer as top coats.
- F. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

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. 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.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. 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 they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board and shop primed steel.
1. Two top coats and one coat primer.
 2. Top Coat(s): Interior Latex.
 - a. Products:
 - 1) Behr Marquee Interior Eggshell Enamel [No.2450]. (MPI #52)
 - 2) Dunn-Edwards Suprema, Interior Eggshell Paint, SPMA30. (MPI #52)
 - 3) Sherwin-Williams Harmony Interior Acrylic Latex, Eg-Shel. (MPI #44)
 - 4) Vista Paint Vista Carefree, Carefree Eggshell Finish, 8300. (MPI #52)
 - 5) Substitutions: Section 01 63 00 - Product Substitution Procedures.
 3. Top Coat Sheen:
 - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include doors and door frames.
 2. Two top coats and one coat primer.

3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153 or 154.
 - a. Products:
 - 1) Behr Interior/Exterior Direct-To-Metal Paint Semi-Gloss, 3200. (MPI #153)
 - 2) Dunn-Edwards Evershield Exterior/Interior Semi-Gloss, EVSH50-2. (MPI #153)
 - 3) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss. (MPI #153)
 - 4) Vista Paint Vista Carefree Carefree Semi Gloss Finish, 8400. (MPI #153)
 - 5) Substitutions: Section 01 63 00 - Product Substitution Procedures.
- C. Paint I-OP-MD-WC - 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. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153, or 154.
 - a. Products:
 - 1) Behr Premium Interior/Exterior Direct-To-Metal Semi-Gloss [No. 3200]. (MPI #153)
 - 2) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss. (MPI #153)
- D. Paint I-OP-DF - 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.
 - a. Products:
 - 1) Behr Pro Dryfall, Flat, PR890, MPI #118.
 - 2) Dunn-Edwards, Aquafall, Flat, W6079, MPI #118.
 - 3) Dunn-Edwards, Aquafall, Low Sheen (Gloss Level 3), W6078.
 - 4) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
 - 5) Vista Paint, W/B Dry Fall - Flat, DF12, MPI #118.
 - 6) Substitutions: Section 01 63 00 - Product Substitution Procedures.
- E. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
 1. One coat of latex primer.
- F. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 1. Touch-up with latex primer.
- G. Paint Mgl-OP-3L - Galvanized Metals, Latex, 3 Coat:
 1. One coat galvanize primer.
- H. Paint Mal-OP-3L - Aluminum, Unprimed, Latex, 3 Coat:
 1. One coat etching primer.
- I. Paint GI-OP-3A - Gypsum Board/Plaster, Alkyd, 3 Coat:
 1. One coat of alkyd primer sealer.
 2. Semi-gloss: Two coats of alkyd enamel; Behr Paint, 3900 Series Interior/Exterior Alkyd Semi-Gloss Enamel.
- J. Paint GI-OP-3LA-VOC - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat, Zero VOC:

1. One coat of latex-acrylic primer sealer.
 2. Semi-gloss: Two coats of latex-acrylic; Behr Paint, 3000 Series Premium Plus Zero VOC Interior Semi-Gloss.
- K. Paint GI-OP-3LA-LV - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat, Low VOC:
1. One coat of latex-acrylic primer sealer.
 2. Gloss: Two coats of latex-acrylic enamel; Behr Paint, 2-8000 Series Premium Plus Interior/Exterior High Gloss Enamel.
- L. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
1. One coat of alkyd primer sealer.
 2. Flat (ceilings): Two coats of latex enamel-acrylic; Behr Paint, 558 Interior Ceiling Flat.

2.04 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 effect 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. 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:
- 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:
- 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 tinted primer.
- 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.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, 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

INTERIOR PAINT SCHEDULE

1. Gypsum Board

Eggshell – **Professional**, Latex, Interior, Low Odor/VOC

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Kilz PVA Interior Primer 10	ProMar 200 Zero VOC Primer B28W02600	Vinylastic Select VNPR00-1
Intermediate Coat:	Behr Pro i300 Interior Eggshell 330	ProMar 200 Zero VOC Eg-Shel B20W2600	SPARTAZERO Eggshell SZR030
Topcoat:	Behr Pro i300 Interior Eggshell 330	ProMar 200 Zero VOC Eg-Shel B20W2600	SPARTAZERO Eggshell SZR030

2. Gypsum Board - Dry Fall Coating (Spray Applied)

Flat – Latex, Interior, Spray Applied

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Plus Drywall Primer Sealer 73	PVA Primer Sealer B28W8000	Vinylastic Premium VNPR00
Intermediate Coat:	Behr Pro Dryfall Flat 890 White/891 Black	Dry Fall Flat B42 Series	Aquafall Flat W6079
Topcoat:	Behr Pro Dryfall Flat 890 White/891 Black	Dry Fall Flat B42 Series	Aquafall Flat W6079

3. Steel, Ferrous Metal

Semi-Gloss – **Professional**, Latex, Interior, Low Odor/VOC

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Multi-Surface Primer 436	ProCryl Universal Primer B66W01310	Bloc Rust Premium BRPR00 2WH
Intermediate Coat:	Behr Pro i300 Interior Semi-Gloss 370	ProMar 200 Zero VOC Semi-Gloss B31-2600	SPARTAZERO Semi-Gloss SZR050
Topcoat:	Behr Pro i300 Interior Semi-Gloss 370	ProMar 200 Zero VOC Semi-Gloss B31-2600	SPARTAZERO Semi-Gloss SZR050

4. Galvanized Metal, Aluminum, and Non-Ferrous Metals

Semi-Gloss – **Professional**, Latex, Interior, Low Odor/VOC

	Behr	Sherwin-Williams	Dunn-Edwards
Pretreatment:	Klean Strip Prep & Etch (GKA30220)	Krud Kutter Metal Clean & Etch	Krud Kutter Metal Clean & Etch
Prime Coat:	Premium Multi-Surface Primer 436	ProCryl Universal Primer B66W01310	Ultra-Grip Premium UGPR00
Intermediate Coat:	Behr Pro i300 Interior Semi-Gloss 370	ProMar 200 Zero VOC Semi-Gloss B31-2600	SPARTAZERO Semi-Gloss SZR050
Topcoat:	Behr Pro i300 Interior Semi-Gloss 370	ProMar 200 Zero VOC Semi-Gloss B31-2600	SPARTAZERO Semi-Gloss SZR050

5. Galvanized Metal and Non-Ferrous Metals – Dry Fall Coating (Spray applied)
 Flat, Latex, Dry Fall

	Behr	Sherwin-Williams	Dunn-Edwards
Prime Coat:	Premium Multi-Surface Primer 436	Multi-Purpose Primer B51-450	Ultra-Grip Premium UGPR00
Intermediate Coat:	Behr Pro Dryfall Flat 890 White/891 Black	Dry Fall Flat B42 Series	Aquafall Flat W6079
Topcoat:	Behr Pro Dryfall Flat 890 White/891 Black	Dry Fall Flat B42 Series	Aquafall Flat W6079

END OF SCHEDULE APPENDIX

SECTION 09 94 50
ARCHITECTURAL DECORATIVE FILMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Architectural Decorative Film.
- B. Graphic artwork cut pattern.

1.02 RELATED REQUIREMENTS

- A. Section 08 43 13 - Aluminum-Framed Storefronts: Windows to receive architectural window film.
- B. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazed windows to receive architectural window film.
- C. Section 08 80 00 - Glazing: Glass to receive architectural window film.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

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 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets on each product to be used.
- C. Shop Drawings:
 - 1. Submit shop drawings covering fabrication, installation and finish of specified systems.
 - 2. Include fully dimensioned plans and elevations with material coordination keys.
 - 3. Show artwork for each film item.
- D. Samples:
 - 1. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - 2. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.
- E. Manufacturer's Qualification Statement.
- F. Specimen Warranty.
- G. Installer's Qualification Statement.
- H. Manufacturer's Instructions:
 - 1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.
 3. Installation methods.
- I. Maintenance Data: Operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
 - J. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.

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. Installer Qualifications: Company specializing in performing the work of this section and approved by manufacturer.
 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 2. Provide a commercial building reference list of five (5) properties where the installer has applied film. This list will include the following information:
 - a. Name of building.
 - b. The name and telephone number of a management contact.
 - c. Type of substrate.
 - d. Type of film.
 - e. Amount of film installed.
 - f. Date of completion.
- C. Single-Source Responsibility: For each separate film graphic type required from one source of a single manufacturer.
- D. Graphic fabricator shall be responsible for the quality and materials and workmanship required for the execution of this contract including the materials and workmanship of any firms or individuals who act as his sub-contractors.
- E. Artwork for specific items as noted on Drawings shall be created to meet design intent. Create artwork, including final artwork for fabrication (including reproducible film positives).
- F. The graphic design requirements shown by the details Drawings show design intent only and intended to establish basic dimensions colors, shapes, profiles, sight lines, and appearance. Maintain visual design concept as shown, including sizes, shapes, colors, and placement as accurately as possible.

1.07 MOCK-UP

- A. Provide film mock-up, one complete window, illustrating installation for evaluation of surface preparation techniques and application workmanship.
- B. Locate where directed.
- C. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
- D. Refinish mock-up area as required to produce acceptable work.
- E. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
- C. Product must remain in original plastic bag and boxes and have storage conditions as follows:
 - 1. 40°F (5°C) - 90°F (32°C) storage temperature range
 - 2. Out of Sunlight
 - 3. Clean dry area
 - 4. Original container
 - 5. Do not stack boxes over six (6) units high. Excessive weight can damage the film
 - 6. Products are not recommended for interior applications where condensation consistently occurs.
 - 7. Handle products in accordance with manufacturer's instructions.
 - 8. Total pre-installation shelf life: 2 years. Up to 2 years unprocessed, OR process within 1 year and apply within 1 year of processing.

1.09 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.
- B. Environmental Limitations: Do not install until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.10 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 ten year manufacturer warranty for appearance and adhesion properties.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials Basis of Design: 3M Company - Commercial Solutions Division [CSD]: www.3m.com.
 - 1. Local Representative: Point of Contact – Michael Hassenauer 651.737.1053. Email: mjhassenauer@mmm.com.
- B. Manufacturers:
 - 1. Flexvue Films: www.flexvuefilms.com.
 - 2. Madico, Inc: www.madico.com.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E84:
 - 1. Flame Spread: 25, maximum.
 - 2. Smoke Developed: 450, maximum.

2.03 MATERIAL PROPERTIES

- A. General: Printed and textured graphic film for factory or field applied application.
- B. Film: Image printed on vinyl 2 mil (50 microns) thickness with luster finish.
 - 1. Base Film Basis of Design Product: 3M Print Wrap Film IJ180mC-10 as manufactured by 3M Company - Commercial Solutions Division CSD, or approved equal.
 - 2. Overlay Film Basis of Design Product: 3M Scotchcal, 8518 Gloss Overlamine as manufactured by 3M Company - Commercial Solutions Division CSD, or approved equal.
 - 3. Edge Sealer Basis of Design Product: Edge Sealer 3950 as manufactured by 3M Company - Commercial Solutions Division CSD, or approved equal.
- C. Decorative Pattern: Printed graphic image to be provided through the Architect.
- D. Adhesive: Acrylic, Pressure Sensitive.
 - 1. Basis of Design Product: Comply(TM) Adhesive with micro technology non-visible air release channels as manufactured by 3M Company - Commercial Solutions Division CSD, or approved equal.
- E. Average Overall Thickness (Film and Adhesive without Liner):

2.04 FABRICATION

- A. Shop fabrication and tolerances for graphic artwork shall conform to the standards of the industry. All items shall be shop fabricated so far as practicable. Perform high-quality, professional workmanship. Fabricate work to proper proportions, with orientation that will be straight, plumb, level and square and to sizes, shapes and profiles indicated on the approved shop drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify pattern prior to material acquisition.
- B. Confirm appropriate substrate is suitable for mounting of finish components prior to start of installation.
- C. Examine substrate(s) for compliance. Do not proceed with installation until unsatisfactory conditions have been corrected.
- D. Reference 3M Technical Data Sheet to determine compatibility of finish to substrate
- E. Responsibility for state of surfaces prior to installation to be pre-determined by installation specialist.
- F. Do not proceed with installation until unsatisfactory conditions have been corrected.
- G. Proceeding with installation implies installer's acceptance of substrate and conditions.

3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Thoroughly clean substrate of substances that could impair the overlay's bond, including mold, mildew, oil, grease.
- C. Re-clean surfaces with appropriate surface prep solvent and remove any haze or surface contamination.

3.03 INSTALLATION

- A. Application must be performed by qualified installer.
- B. Do not proceed with installation until all finishing work has been completed in and around the work area.
- C. Install in accordance with manufacturer's instructions.

3.04 CLEANING

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common cleaning solutions, including ammonia solutions, 30 days after application.
 - 1. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film.
 - 2. Use synthetic sponges or soft cloths.

3.05 EXTRA MATERIALS

- A. Furnish 2 percent extra material at time of installation. Deliver in protective packaging for storage and label contents appropriately.

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, and metal copings/flashings
- B. Surface preparation.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing; 1985.
- B. ASTM D2486 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; 2012.
- C. ASTM D4587 - Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings; 2011.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- F. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.
- G. SSPC-SP 1 - Solvent Cleaning; 2015.
- H. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- I. 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 33 00 - Submittal Procedures 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 63 00 - Product Substitution Procedures, 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-UP

- A. See Section 01 45 00 - Quality Control, for general requirements for mock-up.
- B. Provide mock-up , 8 feet long by 8 feet wide, 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. Restrict traffic from area where coating is being applied or is curing.

1.10 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, 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. Carboline: www.carboline.com.

2. PPG Paints: www.ppgpaints.com/#sle.
3. Precision Coatings: www.precisioncoatingsinc.com/#sle.
4. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
 - a. Local Representative: John Dumesnil, 619.665.9341.
5. Tnemec Company, Inc: www.tnemec.com/#sle.
 - a. Local Representative: Tony Hobbs, 310.637.2363.
6. Substitutions: Section 01 63 00 - Product Substitution Procedures.

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. Scrubbability: Excellent, when tested in accordance with ASTM D2486.
 3. 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. Epoxy Coating:
 1. Number of coats: Two.
 2. Product Characteristics:
 - a. Comply with the performance requirements specified above for moderate exposure.

3. Coating Systems for Exterior Steel:
 - a. Exterior Exposed: Moderate to severe weathering and exposure
 - b. Application: for all exterior AESS, exterior steel, metal canopies, exposed steel decks, hollow metal doors and frames, and metal copings/flashings
 - c. Basis of Design Product: Zinc / Epoxy / Hybrid as manufactured by Tnemec Company, Inc., or approved equal.

Surface Preparation:			SSPC-SP 6
Shop Primer:	Aromatic Urethane, Zinc-Rich	Series 90-97 Tneme-Zinc	DFT 2.5 to 3.5 mils
Intermediate Coat:	Polyamidoamine Epoxy	Series L69 Hi-Build Epoxxline II	DFT 2.5 to 3.5 mils
Finish Coat:	Modified Polycarbamide	Series 750 UVX	DFT 2.5 to 4.0 mils
Total DFT: 7.0 to 10.5 mils			

- d. Finish Color: As selected by Architect from manufacturer's custom colors and As indicated on the drawings.
4. Top Coat(s): Polyamide Epoxy.
 - a. Sheen: Gloss.
 - b. Products:
 - 1) Sherwin-Williams; Macropoxy 646 Fast Cure Epoxy; MPI #177: www.protective.sherwin-williams.com/#sle.
 - 2) Tnemec Company, Inc; Series 287 Enviro-Pox: www.tnemec.com/#sle.
 - 3) Substitutions: Section 01 63 00 - Product Substitution Procedures.
- C. Shellac: Pure, white type.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all 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.
- F. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

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 45 00 - Quality Control, 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 10 11 00
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Markerboards and Tackboards.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 06 41 00 - Architectural Wood Casework: Sliding markerboards integrated with casework.
- C. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- B. ANSI A208.1 - American National Standard for Particleboard; 2009.
- C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a (Reapproved 2016).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
 - 1. Use 2013a as indicated in 2016 CBC Referenced Standards.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit color charts for selection of color and texture of 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. 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 77 00 - Closeout Procedures, 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 MANUFACTURERS

- A. Visual Display Boards:
 - 1. ADP Lemco, Inc.: www.adplemco.com
 - 2. Chatfield-Clarke: www.chafield-clarke.com.
 - 3. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
 - 4. Polyvision Corporation (Nelson Adams): www.polyvision.com/#sle.
 - 5. A-1 Visual Systems Co.: www.a-1visualsystems.com.
 - 6. Nelson Adams NACO, Division of Mega-Met, Inc.: www.nelsonadamsnaco.com.
 - 7. Platinum Visual Systems, a division of ABC School Equipment Co.: www.pvusa.com.
 - 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch .
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Extruded aluminum, with concealed fasteners.
 - 7. Frame Profile: As indicated on drawings
 - 8. Frame Finish: Anodized, natural.
 - 9. Accessories: Provide chalk tray, map rail, and flag holder.
- B. Tackboards: Composition cork.
 - 1. Cork Thickness: 1/8 inch.
 - 2. Color: As indicated on drawings.
 - 3. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
 - 4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Extruded aluminum, with concealed fasteners.
 - 7. Frame Profile: As indicated on drawings
 - 8. Frame Finish: Anodized, natural.
 - 9. Accessories: Provide map rail.
- 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.

2.03 MATERIALS

- A. Porcelain Enamelled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
- E. Adhesives: Type used by manufacturer.

2.04 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. Chalk Tray: Aluminum, manufacturer's standard profile, one piece full length of chalkboard, 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.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of chalk tray at 24 inches above finished floor.
- C. Secure units level and plumb.
- D. Butt Joints: Install with tight hairline joints.

3.03 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 Date of Substantial Completion.

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door symbol signs.
- B. Interior directional and informational signs.
- C. Emergency evacuation maps.
- D. Building identification signs.
- E. Plaque.
- F. Traffic signs.

1.02 RELATED REQUIREMENTS

- A. Section 10 14 53 - Traffic and Parking Signage: Fire lane, accessibility and traffic signage.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- C. Section 26 05 53 - Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2011).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. 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.
 - 3. 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, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.

- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 63 00 - Product Substitution Procedures, for additional provisions.

1.05 QUALITY ASSURANCE

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

1.06 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 tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 - 1. ASI Sign Systems, Inc.: www.asisignage.com.
 - 2. Best Sign Systems, Inc: www.bestsigns.com.
 - 3. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com/#sle.
 - 4. Cosco Industries (non-ADA signs): www.coscoarchitecturalsigns.com/#sle.
 - 5. FASTSIGNS: www.fastsigns.com/#sle.
 - 6. Inpro: www.inprocorp.com/#sle.
 - 7. Mohawk Sign Systems, Inc: www.mohawksign.com.
 - 8. Quiel Signs: www.quielsigns.com
 - 9. Seton Identification Products: www.seton.com/aec.
 - 10. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Dimensional Letter Signs:
 - 1. ASI Sign Systems, Inc.: www.asisignage.com.
 - 2. Cosco Industries; Cast Aluminum: www.coscoarchitecturalsigns.com/#sle.
 - 3. FASTSIGNS: www.fastsigns.com/#sle.
 - 4. Inpro: www.inprocorp.com/#sle.
 - 5. Metallic Arts: www.metallicarts.com
 - 6. A.R.K. Ramos Signage Systems: www.arkramos.com

7. Seton Identification Products: www.seton.com/aec.
 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- C. Plaques:

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
1. Requirements for Persons with Disabilities: Provide identifying devices meeting the requirements for the physically disabled of the following codes:
 - a. California Building Code (CBC) Title 24, Part 2; Chapter 11B, Accessibility.
 2. Raised characters shall comply with CBC 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 Section 11B-703.2.5
 - c. Finish and contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1
 - d. Proportions: It shall be selected from fonts where the width of the uppercase letter "O" is 60 % minimum and 110 % maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character. CBC Sections 11B-703.4 and 11B-703.6.
 - e. Character Spacing: Spacing between individual tactile characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8.
 - f. Format: Text shall be in a horizontal format. CBC 11B-703.2.9.
 - g. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed and rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
 - 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 Section and Figure 11B-703.4.1.
 - i. Mounting location: A tactile sign shall be located per CBC Section 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.

- j. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40 inches minimum above finish floor or ground.
 - k. Pictograms shall comply with CBC Section 11B-703.6.
 - l. Symbol of accessibility shall comply with CBC Section 11B-703.7.
 - m. Variable message signs shall comply with CBC Section 11B-703.8.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
- 1. Sign Type: Flat signs with injection molded or etched panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Character Height: 1 inch.
 - 4. Sign Height: 3 inches, unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. 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 Sections 11B-216.8 and 11B-703.2.6.3.
 - 1) No pictogram, text, or braille is required.
 - 2) If tactile jamb signage is provided, signage shall comply with appropriate technical requirements of CBC Section 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 11B-216.8.1 at the entrances to toilet and bathing rooms.
 - 2) Comply with CBC 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: 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.

- (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.

- 9. Exits: Provide raised character and Braille exit signs per CBC Section 1013.4 at the following locations:

<u>Location</u>	<u>Text</u>
Grade level exit door	EXIT
Exit door to exit stair	EXIT STAIR DOWN, EXIT STAIR UP
Exit door to exit ramp	EXIT RAMP DOWN, EXIT RAMP UP
Exit door to exit enclosure	EXIT ROUTE
Exit door to exit passageway	EXIT ROUTE
Exit door to exit corridor	EXIT ROUTE
Exit door to exit hallway	EXIT ROUTE
Exit door to horizontal exit	TO EXIT

- C. Interior Directional and Informational Signs:

- 1. Sign Type: Same as room and door signs.
- 2. Sizes: As indicated on drawings.
- 3. Wording of signs is scheduled on drawings.

- D. Emergency Evacuation Maps:

- 1. Allow for one map per building.
- 2. Map content to be provided by District.
- 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.

- E. Building Identification Signs:

- 1. Use individual metal letters.
- 2. Mount on outside wall in location indicated on drawings.

- F. Other Dimensional Letter Signs: Wall-mounted.

- 1. Exterior quantities, wording, and custom logo shapes, as indicated on Drawings.

- G. Plaque: See Allowance for details.

2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.

- 1. Edges: Square.
- 2. Corners: Square.
- 3. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
- 4. Wall Mounting of One-Sided Signs: Tape adhesive.
 - a. Provide visually matching back plate when mounted on a glass surface.

- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Background Color: As scheduled.
 4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved or photopolymer etched through face to expose core as background color:
1. Interior Basis of Design Product: InTouch™ ADA-Ready™ Sign System with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes and details as manufactured by ASI Sign Systems, Inc., or approved equal.
 2. Total Thickness: 1/8 inch, matte finished acrylic.
 3. Fabrication:
 - a. Tactile Graphics and Text:
 - 1) Fabrication process: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's photopolymer bonded process. Sign face of single material, tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
 - 2) Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors. Tactile characters to be raised min. 1/32 inch from surface. Computerized translation of sign copy to be responsibility of the manufacturer.
 - b. Letter style[s], color[s], letter size[s] and layout position:
 - 1) As selected by Architect from manufacturer's standard letter style and color charts.
 - c. Text Schedule: As indicated on Drawings.
 - d. Tactile Lettering and Graphics Color Options: As selected by Architect from manufacturer's standard colors.
 - e. Mounting Panel Options:
 - 1) Size:
 - (a) Same size.
 - f. Background Appearance Options:
 - 1) Solid color[s]: As selected by Architect from manufacturer's standard colors.
 - 2) Subsurface custom graphics.
 - g. Overall panel size: As indicated on Drawings.
 - h. Shape: As indicated on Drawings.
- B. Etched Metal Panels: Zinc based panel etched through face to expose core as background color:
1. Exterior Basis of Design Product: SignEtch™ ADA-Ready™ Sign System with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes and details as manufactured by ASI Sign Systems, Inc., or approved equal.

2. Total Thickness: 1/8 inch.
3. Paint: Primer and urethane based color coat, of type standard with manufacturer.
 - a. U.V. resistant clear urethane top coat required for exterior applications.
4. Fabrication:
 - a. Tactile Graphics and Text:
 - 1) Fabrication process: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's photochemical etching.
 - 2) Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.
 - b. Letter style[s], color[s], letter size[s] and layout position:
 - 1) As selected by Architect from manufacturer's standard letter style and color charts.
 - c. Raised text and graphic finishes:
 - 1) Colors/Sheen:
 - (a) As selected by Architect from manufacturer's standard colors.
 - (b) Finish: Matte.
 - d. Text Schedule: As indicated on Drawings.
 - e. Edge Detail: Square.
 - f. Edge Finish: Brushed.
 - g. Overall panel size: As indicated on Drawings.
 - h. Recessed Graphics Color Options:
 - 1) As selected by Architect from manufacturer's standard colors.
 - i. Recessed Area Texture Options:
 - 1) Smooth paint.

2.05 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
 1. Sign Color: Clear.
 2. Total Thickness: 1/8 inch.

2.06 PLAQUES

- A. Metal Plaques:
 1. Metal: Bronze casting.
 2. Metal Sheet Thickness: 1/8 inch, minimum.
- B. Dedication Plaque: Provide on 30 inch square cast bronze dedication plaque containing information obtained from District and including the following:
 - SCHOOL NAME
 - BOARD MEMBERS (List names and Titles)
 - SUPERINTENDENT'S NAME
 - CABINET STAFF (List five names and Titles)

LOGO (To be provided)

ARCHITECT'S NAME

CONTRACTOR

DATE

2.07 DIMENSIONAL LETTERS

- A. Fabricated Letters:
 - 1. Height: As indicated on Drawings.
 - 2. Depth: As indicated on Drawings.
 - 3. Letter style: As indicated on Drawings.
- B. Metal Letters:
 - 1. Metal: Aluminum, welded fabrication.
 - 2. Mounting: Projecting Stud Mount.

2.08 LOW LEVEL EXIT SIGNS (NON-ELECTRICAL)

- A. Acrylic photoluminescent edge-lit exit sign, non-electrical, non-radioactive, stenciled letters with directional arrows where indicated and/or required.
 - 1. Comply with CBC 1013.5 and 1013.7.
 - 2. Mounting Bracket: Anodized aluminum; Wall mount, dual facing where indicated on Drawings.
 - 3. Visibility Rating: 50 feet.
 - 4. Dimensions: 8-1/2 inches high by 14-1/2 inches wide, 1/8 to 1/4 inch depth.
 - 5. Faceplate: Single mirror, ultra-clear acrylic with rounded corners.
 - 6. Vandal Resistant
 - 7. Graphics: 6 inches high.
 - a. Comply with CBC 1013.6.1.
 - b. Letter color: Green with red outline.
 - c. Directional Arrows: Field applied with adhesive.
 - 8. Listing: UL 924.
 - 9. California State Fire Marshal Approval: Yes.
 - 10. Warranty: Limited Lifetime.
 - 11. Products: Or Equal.
 - a. Active Safety; ECO-CLEAR Series 2003: www.activesafety.com.

2.09 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material.

- C. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material.
- D. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- E. Exposed Screws: Stainless steel.
 - 1. Exposed fasteners are permitted only where specifically indicated, and shall be tamper proof stainless steel, countersunk, and may be painted or finished to match adjacent surfaces.
- F. Tape Adhesive: Double sided tape, permanent adhesive.
- G. Adhesives:
 - 1. Type recommended by the manufacturer of the material specified to be laminated or adhered.
 - 2. No adhesives that fade, discolor or delaminate as a result of proximity to sunlight or heat therefrom shall be used.
 - 3. Adhesives shall not change the color or otherwise deteriorate the materials to which they are to be applied.
 - 4. The adhesives shall be of non-staining, non-yellowing quality.
- H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Do not start work until deficiencies have been corrected. Start of work of this section constitutes acceptance of the surfaces.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mounting Method:
 - 1. Mount signs to surfaces with a minimum of four countersunk tamperproof stainless steel fasteners.
 - 2. Provide anchorage where necessary for fastening signs securely in place.
 - a. Anchorage not otherwise specified or indicated shall include expansion shields and power-driven fasteners;
 - 1) when approved:
 - (a) for concrete and masonry;
 - (b) toggle or molly bolts to plaster surfaces;
 - (c) full threaded wood screws to wood doors;
 - (d) machine or metal screws to metal doors.
 - b. Provide backing plates for mounting to expanded metal substrates.
 - 3. Adhere signs to glass with adhesive.

- C. Install neatly, with horizontal edges level.
- D. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and CBC 11B.
 - 1. Room and Door Signs: Locate on wall at latch side of door a minimum of 48 inches to the baseline of the lowest braille cells; with top of highest line of raised character text at 60 inches above finished floor.
 - a. Comply with CBC 11B-703.4.1
 - 2. Low-Level Exit Signs: Locate bottom of the sign not less than 6 inches nor more than 8 inches above floor level. Indicate direction for exit path of travel.
 - a. Comply with CBC 1013.7.
- E. Protect from damage until Substantial Completion; repair or replace damaged items.

3.03 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 53
TRAFFIC AND PARKING SIGNAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Traffic and parking control, plaque, and informational signage.
- B. Sign supports and foundations.

1.02 RELATED SECTIONS

- A. Section 10 14 00 - Signage: Informational signage in addition to on-site signage specified in this section.
- B. Section 32 17 23.13 - Pavement Marking: Painted accessibility marking.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.
- C. FED-STD-595C - Colors Used in Government Procurement (Fan Deck); 2008 (Chg Notice 1).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including location, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. 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.
 - 2. Submit for approval by District through Architect prior to fabrication.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable Codes and regulations of authorities having jurisdiction for accessible parking stall identification, including the following:
 - 1. California Code of Regulations (CCR), Title 24, Parts 2, 3 and 5.
 - 2. California Building Code (CBC) Section 11B-502.6, including amendments and supplements as adopted by Authority Having Jurisdiction (AHJ) as shown on Drawings.
 - 3. Manual on Uniform Traffic Control Devices as adopted by the State Department of Transportation.
 - a. Reflectively requirements

PART 2 - PRODUCTS

2.01 TRAFFIC AND PARKING CONTROL SIGNAGE

- A. Manufacturers:
1. Hawkins Traffic Safety Supply, Inc.: www.hawkinstraffic.com.
 2. Safeway Sign Company: www.safewaysign.com.
 3. Western Highway Products, Inc.: www.westernhighway.com.
- B. 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.
1. 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.
 - a. Single post mount, not less than 17 x 22 inches with white reflectorized copy on blue background conforming to No. 15090, FED-STD-595C, one inch high letters shall read: "Unauthorized vehicles parked in designated accessible spaces not displaying distinguishing placards or special license plates issued for persons with disabilities will be towed away at the Owner's expense. Towed vehicles may be reclaimed at Campus Police or by telephoning 310.900.1600, ext. 2999."
 - 1) Contractor shall verify the phone numbers from District for permanent inclusion in sign copy, prior to fabrication of the signs.
 - b. 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.
 - c. 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.
 2. Parking Stall Signs: Sign text, accessible parking control shall comply with requirements of State of California Code of Regulations (CCR) - Title 24, Part 2, Section 11B-502.6 in addition to requirements of State of California, Department of Transportation (CALTRANS) and regulations of local authorities having jurisdiction.
 - a. Single post mount, not less than 70 square inches with white reflectorized copy on blue background conforming to No. 15090, FED-STD-595C. Sign shall display a profile view of a wheelchair with occupant in white on blue background.
 - 1) Provide an additional sign below the accessible sign with the text "Minimum Fine \$250".
 - b. Position one sign at the end of each parking space designated for disabled usage.
 - c. One in every six spaces (CBC 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 11B-502.6, 36 CFR 1191, and ADA Standards.

- d. 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.
3. Fire Lane Signs:
- a. Single post mount, of size, color and sign text as shown on site plan or as required by local codes and fire department authority.
 - b. Quantity, location and mounting heights to be determined by local fire department authority.

2.02 ACCESSORIES AND FASTENERS

- A. Accessories: Provide welded galvanized steel fittings and galvanized or cadmium-plated steel bolts, nuts and washers.
- B. Fasteners: Provide tamper-proof galvanized steel fasteners, Tufnut System (714) 962-5838, Allegheny Bolt (Tampruf brand; (516) 568-1052 or equal.

2.03 SIGN SUPPORTS AND FOUNDATION

- A. Support Posts: 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; 2,500 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.
- C. Provide other materials as necessary for complete installation, as recommended by manufacturer and selected by Contractor, subject to approval of Architect.

2.04 FABRICATION

- A. Provide signs and supports factory-prefabricated and pre-finished, ready for assembly and installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means installer accepts existing surfaces.

3.02 INSTALLATION

- A. 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.
- B. Locate informational signage as verified in field by District. 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.
 - 1. 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.
 - 2. Signs mounted to walls shall be attached firmly with appropriate expansion anchors or bolting, adhesive not permitted.
 - 3. Seal all holes water tight.
- E. Set sign support post plumb and so sign face will be perpendicular to stall or parallel to curb face, as applicable. Set posts into pipe sleeve inserts set and anchored into concrete. Fill annular space between posts and sleeves with grouting compound.
- F. Install plaque signage to posts, with panel facing traffic as necessary.

END OF SECTION

SECTION 10 21 13.17
PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal screens.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.
- B. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- C. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports, included in wall framing and plates and above ceiling framing.
- D. Section 10 28 00 - Toilet Accessories.
- E. California Building Code (CBC) chapter 11B, disabled accessibility regulations.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

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 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- 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. Working Mock-up: Submit the following.
 - 1. Submit mock-ups of showing specified hardware types.
 - 2. Submit mock-ups of specified and proposed substitute manufacturers.

- F. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 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.

1.07 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.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide ten year manufacturer limited warranty for panels, doors and stiles against breakage, corrosion and delamination.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. 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.
- B. California Building Code (CBC) disabled accessibility regulations.
 - 1. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.
 - 2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4.
 - 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 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 Section 11B-213.3.1 and shall comply with CBC Section 11B-604.8.2.

4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that 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 Figure 11B-604.8.2.
5. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the 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 11B-604.8.2.2.

2.02 RECYCLE CONTENT

- A. Credit Summary for cumulative total recycled content requirements. This item may contain post-consumer or post-industrial recycled content.
- B. Recycled materials percentage of pre-consumer and post-consumer recycled content per shall be as noted below:
 1. 20% Post-Industrial or Pre-Consumer, (by rule this is reduced by one-half.)
 2. 10% Post-Consumer,
 3. Total 20% by any combination of the above factors.

2.03 MANUFACTURERS

- A. Basis of Design Product: Sierra Series, 1092G.67P as manufactured by Bobrick Washroom Equipment, or approved equal.

2.04 PHENOLIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, or Solid Color Reinforced Composite (SCRC), floor-mounted headrail-braced.
 1. Privacy Style Partitions: No sightlines with gap-free interlocking doors and stiles routed 0.3 inch nominal from the edge to allow for 0.175 inch nominal overlap to prevent line-of-sight into the toilet compartment.
 - a. Privacy strips fastened or adhered onto the partition material are not acceptable.
 2. Floor Clearance: 4 inches, nominal.
 3. Color: As selected by Architect from Manufacturers custom palette.
- B. Doors:
 1. Thickness: 3/4 inch.
 2. Width: 24 inch.
 3. Width for Handicapped Use: 36 inch.
 4. Height: 72 inches.
- C. Panels:
 1. Thickness: 1/2 inch.
 2. Height: 72 inches.

3. Depth: As indicated on drawings.
- D. Pilasters:
 1. Thickness: 3/4 inch.
 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with continuous panel brackets with vertical support post/pilaster to ceiling.
 1. Urinal Screens: Wall mounted with continuous panel brackets.
 - a. Thickness: 3/4 inch.
 - b. Post to ceiling support.
 - c. Height: 72 inches.
 - d. Floor Clearance: 4 inches, nominal.
 - e. Depth: 24 inches.

2.05 FABRICATION

- A. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required.

2.06 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch 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: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
- C. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- E. Hardware: Polished stainless steel:
 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - a. Wrap-around, self-closing type, designed to hold door slightly open to indicate vacant compartment.
 - 1) Cam action hinge assembly.
 - b. Emergency Access: Provide by lifting door.
 - c. Plastic inserts and end caps are not acceptable.
 - d. Provide full length hinges on oversize doors.
 2. Door Latch: Slide type with exterior emergency access feature.
 - a. Configuration: Surface mounted and through bolted to door with one way sex bolts
 - b. Material: Cast stainless steel.

3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - a. Configuration: Wrap around flange surface mounted and through bolted to pilaster with one way sex bolts
 - b. Material: Cast stainless steel.
 - c. Strikes: 6 inches long.
 - d. Door bumper to accommodate projection of all door hardware and toilet accessories.
4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - a. Mount such that no portion is over 47 inches above finish floor.
 - b. Provide only if not provided under Section 10 28 00 - Toilet Accessories. If not otherwise provided or shown on Drawings, provide one at each toilet stall door.
5. Provide door pull for outswinging doors.
 - a. Surface mounted U-shaped or wire pulls on both sides of accessible compartment doors.
 - b. Material: Cast stainless steel.
 - c. Basis of Design Product: Guardian #5403 with 3-1/2 inch centers as manufactured by Alan Lewis Inc., or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to application of gypsum board tile backing or other wall finishes, inspect framing at toilet compartments and urinal screens and ensure that necessary and proper backing is provided in wall for anchoring of panels.
- B. Verify that field measurements are as indicated on shop drawings.
- C. Verify correct spacing of and between plumbing fixtures.
- D. 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.
 1. Use fasteners as shown on reviewed shop drawings.
 - a. Where fasteners to substrate are not indicated, provide fasteners as specified in Section 05 05 19 - Post-Installed Concrete Anchors.
 2. Secure divider panels to built-in anchorage devices using concealed fasteners. Level, plumb and tighten installation with devices provided.
 3. Anchors to Concrete:
 - a. Use stainless steel expansion anchors, or self-threading concrete anchors.

- b. Power-driven fasteners or lead expansion shields are not acceptable.
- 4. Anchors to Plaster or Gypsum Wallboard (with and without tile finish):
 - a. Use sheet metal screws to metal framing or backing, wood screws to wood framing or backing.
 - b. Molly-type fasteners are not acceptable.
- 5. Panel-to-Wall Installation:
 - a. Provide clearances of not more than 1 inch between panels and walls.
 - b. Secure panels to walls with continuous brackets so that holes for wall anchorage occur in masonry or tile joints.
 - c. Secure panels in position with manufacturer's recommended anchoring 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. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

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 22 39
FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Top-supported folding panel partitions, horizontal opening.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Overhead track structural support framing.
 - 1. Primary structural support, including pre punching of support members by steel supplier in accordance with template supplied by operable partition suppliers template.
- B. Division 26 - Equipment Wiring: Electrical characteristics and wiring connections; control buttons.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- C. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings; 2016.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- E. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- F. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- G. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.
- H. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 1996 (Reapproved 2009).
- I. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2015.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
 - 1. Require attendance by representatives of installer.
 - 2. Notify Architect four calendar days in advance of scheduled meeting date.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.
- C. Product Test Reports: From an independent testing agency indicating that each operable panel partition complies with requirements.
 - 1. Report for STC. Test operable partitions in accordance with ASTM E90 test procedure to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
 - 2. Proof load testing of track/trolley/bracket/hanger rod assembly.
 - 3. Other proof load tests as may be identified in the "PART 2" of this specification.
- D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.
- E. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.
- F. Samples for Review: Submit two samples of surface finish, 12 by 12 inches size, illustrating quality, colors selected, texture, and weight.
- G. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
- H. Manufacturer's Instructions: Indicate special procedures.
- I. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this section approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in protective packaging.
- B. Deliver materials in order as required by schedule for installation.

- C. Handle materials in accordance with manufacturer's instructions.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.11 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

- A. Basis of Design Product: 640 Series, STC 55 as manufactured by Hufcor, or approved equal.
- B. Folding Panel Partitions: Side opening; continuous hinged panels; side stacking; motor operated.
- C. Panel Construction:
 - 1. Frame: 16 gage, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
 - 2. Panel Substrate Facing: Steel sheet, 22 gage, 0.0299 inch thickness.
 - 3. Panel Properties:
 - a. Thickness With Finish: 3 inches.
 - b. Width: Equal widths.
 - c. Weight: 10 lb/sq ft maximum.
- D. Panel Finishes:
 - 1. Facing: Vinyl coated fabric.
 - a. ASTM F793 Category IV/color as selected from manufacturer's standard range.
 - 2. Facing: Markerboard, both sides.
 - a. Porcelain glass fiber enamel, baked to sheet panel surface, color as selected from manufacturer's standard range.
 - b. Size: 48 inches high. Maximum 34 inches to bottom.
 - c. Markerboard Trim: Match panel trim finish.
 - 3. Exposed Metal Trim: Clear anodized.
- E. Panel Seals:
 - 1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
 - 2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor and ceiling seals, and above track to structure acoustic seal.
- F. Suspension System:

1. Track: Formed steel; 1-1/4 by 1-1/4 inch size; thickness and profile designed to support loads, steel sub-channel and track connectors, and track switches.
 2. Carriers: Steel, ball bearing wheels on trolley carrier at top of every individual panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.
- G. Performance:
1. Acoustic Performance:
 - a. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
 - b. Sound Transmission Class (STC): Minimum 55 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
 - 1) If field sound tested, wall/s shall achieve a minimum 44 NIC when tested in accordance with ASTM E336 and providing that the surrounding building is compatible with this rating.
 2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
 3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
 - a. Limit track deflection to no more than 0.10 inch between bracket supports.
- H. Operation:
1. Electric Operator: 12 inches per second traveling speed; adjustable friction clutch brake actuated by solenoid controlled motor starter; enclosed limit switch; enclosed magnetic reversing starter.
 2. Control Station: One standard keyed, three button OPEN-STOP-CLOSE type; 24 volt circuit; surface mounted.
 - a. Key switch prepared for mortise lock cylinder.
 - b. Key switches alike.
 3. Safety Features:
 - a. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
 - b. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.
 - c. Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.
 4. Electrical Requirements:
 - a. 1/2 hp.
 - b. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
 - c. Disconnect Switch: Factory mount disconnect switch in control panel.
- I. Accessories:
1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments, and intermediate meeting posts.

2. Pocket Enclosures: Door, frame, and trim to match adjacent walls.
3. Acoustic Sealant: As recommended by partition manufacturer.

2.02 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Vinyl Coated Fabric: ASTM F793/F793M, Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.
- C. Markerboard: Porcelain enamel on steel, laminated to core; color as selected.
- D. Acoustic Insulation:
 1. Type: As required for acoustic performance indicated.
 2. Thickness: As required for acoustic performance indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Examine flooring, structural support, and opening, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.
- D. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.
- E. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.
- F. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Install operable wall/s and accessories after other finishing operations, including painting, have been completed.
- C. Install panels in sequence as indicated on the shop drawings.
- D. Install electric operator, wiring, and controls. Locate control station(s) as indicated.
- E. Fit and align partition assembly level and plumb.
- F. Lubricate moving components.
- G. Install acoustic sealant to achieve required acoustic performance.
- H. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
- C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING AND PROTECTION

- A. Clean finish surfaces and partition accessories.
 - 1. Clean soiled surfaces on completing installation of operable panel partitions, to remove dust, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Condition markerboard surfaces in accordance with manufacturer's instructions.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of partition and identify potential operational problems.
- B. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.
 - 1. Test and adjust seals, hardware, carriers, tracks, pass doors, pocket doors, controls, safety devices and other operable wall components. Replace damaged or malfunctioning operable components.
 - 2. Train owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 3. Review data in maintenance manuals.

END OF SECTION

SECTION 10 28 00
TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Electric hand/hair dryers.
- C. Diaper changing stations.
- D. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Concealed supports, included in wall framing and plates.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports for accessories, including in wall framing and plates and above ceiling framing.
- C. Section 10 21 13.19 - Plastic Toilet Compartments.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).
- G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004 (Reapproved 2016).

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 33 00 - Submittal Procedures, 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 63 00 - Product Substitution Procedures, 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 physically disabled of the California Building Code (CBC), Title 24 Part 2, and 2010 ADA Standards, as amended.
- B. Accessible requirements:
 1. Elements of sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612.
 2. Grab bars in toilet facilities and bathing facilities shall comply with CBC Section 11B-609.
 - 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 Section 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 Section 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 11B-609.3.
 5. Toilet tissue dispensers are to be continuous flow type. CBC Section 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.

2.02 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 1. ASI - American Specialties, Inc: www.americanspecialties.com.
 2. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 3. Bradley Corporation: www.bradleycorp.com.
 4. Gamco: www.gamcousa.com.
 5. Georgia-Pacific Professional: www.blue-connect.com.
 6. Substitutions: Section 01 63 00 - Product Substitution Procedures.

- B. 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. Adhesive: Two component epoxy type, waterproof.
- F. Fasteners, Screws, and Bolts: Stainless steel except where fully concealed may be hot dip galvanized; tamper-proof; security type.

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. Toilet Paper Dispenser: Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, semi-recessed, stainless steel unit with pivot hinge.
 - 1. Basis of Design Product: B-3888 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- B. 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. Basis of Design Product: B-290.1836 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- C. Seat Cover Dispenser: Stainless steel, recessed, reloading by concealed opening at base, tumbler lock.
 - 1. Minimum capacity: 250 seat covers.
 - 2. Basis of Design Product: B-3013 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.

- D. Grab Bars: Stainless steel, smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - 1) Minimum Length for Side Wall of Water Closet: 48 inches.
 - 2) Minimum Length for Rear Wall of Water Closet: 42 inches.
 - d. Basis of Design Product: Snap Flange B-6806 Series as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- E. Clothes Hook and Bumper: Satin stainless steel clothes hook.
 - 1. Mounting: Concealed wall plate.
 - 2. Basis of Design Product: B-233 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- F. 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. Basis of Design Product: B-353 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.

2.06 UNDERLAVATORY GUARD:

- A. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
- B. Material and Finish: Antimicrobial, molded plastic, white.
- C. Manufacturers:
 - 1. Plumberex Specialty Products, Inc.; Pro-Extreme: www.plumberex.com.
 - 2. Bradley Corporation : www.bradleycorp.com.
 - 3. IPS Corporation Lav Guard 2 Undersink Pipe Covers: www.ipscorp.com.
 - 4. IPS Corporation TrueBro Lav Shield: www.ipscorp.com.

2.07 ELECTRIC HAND/HAIR DRYERS

- A. Electric Hand Dryers: fan-in-case type, with downward nozzle.
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Style: Contemporary styling, fixed nozzle.
 - 3. Mounting: Surface mounted.
 - 4. Cover: Polycarbonate.
 - a. Color: As selected by Architect.
 - b. Tamper-resistant screw attachment of cover to mounting plate.
 - 5. Air Velocity: 36,900 linear feet per minute, minimum, at full power.
 - 6. Total Wattage: 1400 W, maximum.
 - 7. Runtime: Field adjustable, from approximately 10 seconds to approximately 35 seconds

8. Warranty: 3 years.
9. Electric Hand Dryer Products:
 - a. Basis of Design: Dyson, Inc.; AirBlade V: www.dyson.com/handdryers.

2.08 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 1. Material: Polyethylene.
 2. Mounting: Surface.
 3. Color: As selected.
 4. Minimum Rated Load: 250 pounds.
 5. Product: See schedule on Drawings.

2.09 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
- 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. Basis of Design Product: B-224 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.

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. See Section 05 40 00 and 09 21 16 for 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 maximum , measured 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. Electric Hand Dryers: Measured from floor to bottom of nozzle:
 - a. Men: 40 inches.
 - b. Women: 40 inches.
 - c. Handicap: 36 inches.
 - 7. Other Accessories: As indicated on drawings.

3.04 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

3.05 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.
- C. Fire extinguisher cabinets.
- D. 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; 2013a.
- B. FM (AG) - FM Approval Guide; current edition.
- C. Fire Extinguishers Standard: California Fire Code (CFC) section 906.
- D. Title 19 California Code of Regulations.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
 - 1. Use 2012a as indicated in 2016 CBC Referenced Standards.
- F. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- G. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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 and Title 19 CCR.
 - 1. Fire Extinguisher cabinets must comply with CBC sections 11B-305 Clear floor or ground space, 11B-307 Protruding Objects, 11B-308 Reach Ranges, 11B-309/811.4 Operable Parts, 11B-403 Walking Surfaces, 11B-811.3 Height.
 - 2. Comply with Section 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 Section 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; JL Model Cosmic Series: 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; Product Model No. MP5: www.larsensmfg.com.
 - 6. Nystrom, Inc: www.nystrom.com/sle.
 - 7. Potter-Roemer; Product Model No. 300S: www.potterroemer.com.
 - 8. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 9. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group; CS Series - Heavy Duty School Fire Extinguisher Cabinets: www.activarcpg.com/#sle.
 - 2. Ansul, a Tyco Business: www.ansul.com/#sle.
 - 3. Kidde, a unit of United Technologies Corp: www.kidde.com.
 - 4. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 5. Nystrom, Inc: www.nystrom.com.
 - 6. Potter-Roemer; Alta Series: www.potterroemer.com/#sle.
 - 7. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 8. Strike First Corporation of America: www.strikefirstusa.com.
 - 9. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.03 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 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:B:C.
 - 3. Size: 2.5 pound.
 - 4. Size and classification as scheduled.
 - 5. Finish: Baked polyester powder coat, color as selected.
- C. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
 - 1. Class: K type.
 - 2. Size: 1.6 gallons.
 - 3. Size and classification as scheduled.
 - 4. Finish: Polished stainless steel.
 - 5. Temperature range: 32 degrees F to 120 degrees F.

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 primed steel sheet; 0.036 inch thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- D. Cabinet Configuration: Semi-recessed type.
 - 1. Size to accommodate accessories.
 - 2. Trim: Flat square edge, with 1 inch wide face.
 - 3. Projected Trim: Returned to wall surface, with 2-1/2 inch projection, and 2-1/2 inch wide face.
 - 4. 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 nylon catch. Hinge doors for 180 degree opening with two butt 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 duo-panel with glazing, continuous hinge, roller catch, zinc plated pull handle and cylinder lock.
 1. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
 2. 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. 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 ACCESSORIES

- A. Fire Blanket: Fire retardant treated wool; red, 62 by 84 inch size.
- B. Extinguisher Brackets: Formed steel, chrome-plated.
 1. 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.
- C. Cabinet Signage:....
 1. Identify extinguisher locations with red lettered white decals spelling "FIRE EXTINGUISHER INSIDE" applied to wall or exterior door surface outside each room housing a fire extinguisher. Letter size, style and location as selected by Architect, to comply with local fire authority requirements.

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 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 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 SCHEDULES

- A. All extinguishers and cabinets shall be quantities and locations as indicated per Drawings or as indicated by field inspection by Fire Marshall.
- B. 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 = 50 Feet
 3. Class C = 50 Feet
 4. Class K = 30 Feet
- C. Kitchen: 1 fire blanket, 1 Dry Chemical Type 1A:K, 1.6 Gallon (6 liter) capacity, stainless steel finish extinguisher placed in specified cabinet. Ansul K-Guard Model K01-2 Hand Portable Extinguisher.
- D. Multi-Purpose Room: 1 Dry Chemical Type 4A-80BC, 10 lb. capacity, baked enamel finish extinguisher placed in specified cabinet. Ansul Sentry 10 Model No. AA10S.
- E. General Use: 1 Dry Chemical Type 2A-10BC, 10 lb. capacity, baked enamel finish extinguisher placed in specified cabinet. Ansul Sentry 10 Model No. AA10S.
- F. Classroom Use: 1 Dry Chemical Type 2A-10BC, 2.5 lb. capacity, baked enamel finish extinguisher placed in specified cabinet. Ansul Sentry 10 Model No. AA10S.

3.04 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 71 13.43
FIXED SUN SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modular, shop fabricated, extruded aluminum sun screens to be mounted on structure provided by others.

1.02 RELATED REQUIREMENTS

- A. Section 08 43 13 - Aluminum-Framed Storefronts: Mounting substrates.
- B. Section 08 44 13 - Glazed Aluminum Curtain Walls: Mounting substrates.

1.03 REFERENCE STANDARDS

- A. AATCC Test Method 134 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.
- B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- I. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2013a.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing all profiles, sections of all components, finishes, fastening details, and manufacturer's technical and descriptive data. Include field dimensions of openings and elevations on shop drawings.
- C. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
- D. Samples: 10 inches by 10 inches minimum illustrating design, workmanship and finish color.

- E. Sample of Louver: For review of shape only.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Specimen Warranty: Furnish a copy of manufacturer's standard warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section.
 - 1. With minimum five years of documented experience.
 - 2. Approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

1.07 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Sun Screens: Correct defective work within a one year period after Date of Substantial Completion.
- C. Finish Warranty: Provide manufacturer's ten year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fixed Sun Screens:
 - 1. Same manufacturer as curtain wall to which sun screens are to be attached.
 - 2. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 SUN SCREENS

- A. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 - 1. Configuration: As indicated on drawings.
 - 2. Louver Type: Bar.
 - 3. Outrigger Shape: Straight.
 - 4. Design Criteria: Design and fabricate to resist the following loads without failure, damage, or permanent deflection:
 - a. Per ASCE 7 and as indicated on Structural Design Criteria on Drawings General Note sheet.

- b. Thermal Movement: Plus/minus 1/8 inch, maximum.
- 5. Sizes: As indicated on drawings.
- 6. Exposed Aluminum Finish: Superior performing organic coatings.
- 7. Provide a complete system ready for erection at project site.

2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B209 (ASTM B209M) or ASTM B221 (ASTM B221M).
- B. Aluminum Coated Steel Sheet: ASTM A792/A792M.
- C. Concealed Structural Supports: Aluminum, or steel coated for corrosion resistance and dissimilar metal isolation.
- D. Fasteners: ASTM F593 stainless steel or ASTM A307 carbon steel.

2.04 FINISHES

- A. Superior Performing Organic Coatings: AATCC Test Method 134 multiple coat, thermally cured polyvinylidene fluoride system.
- B. Finish Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that dimensions of supporting structure are within plus/minus 1/8 inch of dimensions indicated on shop drawings.
- C. Verify that all adjacent painting, roofing, masonry work, and other work that might damage sun screen finish has been completed prior to installation of sun screens.
- D. Do not install until after all adjacent painting, roofing and masonry have been completed.
- E. Do not proceed with installation until all conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Set units level, plumb, with uniform joints, and aligned with building elements.
- C. Separate dissimilar metals using concealed bituminous paint or non-absorbent gasket.
- D. Anchor units to structure as indicated on drawings.
- E. Do not cut or trim aluminum members without approval of manufacturer; do not install damaged members.
- F. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.03 TOLERANCES

- A. Maximum Variation from Level: Plus/Minus 1/8 inch.

3.04 CLEANING

- A. Clean exterior surfaces units of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.05 PROTECTION

- A. Protect units after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION

SECTION 11 52 13
PROJECTION SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Front projection screen assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Supports for suspended projection screens.
- B. Section 09 21 16 - Gypsum Board Assemblies: Suspended gypsum board ceilings for recessed screens, and openings in gypsum board partitions for fixed and rear projection screens.
- C. Section 09 51 00 - Suspended Acoustical Ceilings: Suspended panel ceilings for recessed screens.
- D. Division 26 - Electrical: Electrical supply, conduit, and wiring for electric motor operated projection screens.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Wiring diagrams for motor operators and actuators, and controls and switches.
- C. Shop Drawings: For custom installations, indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
- D. Samples: For screen fabrics, submit two samples 6 x 6 inch in size.
- E. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.

1.04 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 the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.

- B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F, and stack in accordance with manufacturer's recommendations.
- C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

- A. Maintain interior of building between 60 degrees F and 75 degrees F during and after installation of projection screens.

1.07 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide one year manufacturer warranty for projection screen assembly.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Da-Lite Screen Company: www.da-lite.com/#sle.
- B. Draper, Inc: www.draperinc.com/#sle.
- C. Stewart Filmscreen Corporation: www.stewartfilmscreen.com/#sle.
- D. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 FRONT PROJECTION SCREENS

- A. Manufacturers:
 - 1. Da-Lite Screen Company: www.da-lite.com.
 - 2. Draper, Inc (Motorized); Premier: www.draperinc.com/#sle.
 - 3. Draper, Inc (Manual); Luma Series: www.draperinc.com/#sle.
 - 4. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Front Projection Screens: Factory assembled unless otherwise indicated.
 - 1. Dimensions: As indicated on drawings.
 - 2. In Classrooms: Manual, matte light diffusing fabric screen, horizontally tensioned, wall mounted.
 - 3. In Classrooms: Motorized, matte light diffusing fabric screen, horizontally tensioned, ceiling mounted.
 - 4. In Classrooms: Motorized, matte light diffusing fabric screen, horizontally tensioned, ceiling recessed.
 - 5. In Lecture Halls: Motorized, matte light diffusing fabric screen, horizontally tensioned, wall mounted.
- C. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
 - 1. Material: High contrast gray vinyl on fiberglass backing, with nominal gain of 0.8 over viewing angle not less than 70 degrees from axis, horizontally and vertically.

2. Seams: No seams permitted in fabric up to 96 inch high by 72 inch wide.
- D. Reflective Screen Fabric: Angularly reflective surface; flame retardant and mildew resistant.
 1. Material: Pearly finished vinyl without backing, with nominal gain of 1.5 on axis, not less than 0.75 at 35 degrees from axis.
 2. Seams: No seams permitted in fabric up to 96 inch high by 72 inch wide.
- E. Masking Borders: White, on four sides.
- F. Extra Drops: White; 11 inch wide.
- G. Exposed Screen Cases: Steel, with integral roller brackets.
 1. Finish: Baked enamel.
 2. Color: White.
 3. End Caps: Steel; finished to match case.
 4. Mounting: Wall.
- H. Concealed-in-Ceiling Screen Cases: Steel, with integral roller brackets.
 1. Door Slat: Self trim; self-closing and -opening.
 2. Case Finish: Baked enamel.
 3. Case Color: White.
 4. End Caps: Steel; finished to match case.
- I. Manually-Operated Screens:
 1. Roller: 1-3/4 inch aluminum; spring loaded with locking device.
 2. Screen Pull: Ring on bottom bar.
 3. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
 4. Horizontal Tensioning: Not required.
- J. Electrically-Operated Screens:
 1. Roller: Steel, 2 inch in diameter, with locking device.
 2. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
 3. Horizontal Tensioning: Not required.
- K. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

2.03 ELECTRICAL COMPONENTS

- A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.
- B. Motors: Direct drive, 110 V, 60 Hz.
 1. Screen Motor: Mounted inside roller; three wire with ground; quick reverse type and lifetime lubricated; equipped with thermal overload cut-off, internal junction box, electric brake, and pre-set accessible limit switches.

- a. Electrical Characteristics: 2.6 amps.
- b. Motor mounted on sound absorber.
- C. Controls: Three (3) position control switch with plate.
 - 1. Provide two control stations to screen, with internal override to prevent more than one signal reaching the screen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is finished and ready to accept screen installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that openings for recessed screens are correctly sized.
- D. Verify type and location of electrical connections.
- E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 PREPARATION

- A. Coordinate screen installation with installation of projection systems.
- B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.
- B. Do not field cut screens.
- C. Install screens in mountings as specified and as indicated on drawings.
- D. Install plumb and level.
- E. Install electrically operated screens ready for connection to power and control systems by others.
- F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.
- G. Test electrical screens for proper working condition. Adjust as needed.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Protect rigid rear projection screens with temporary covering over optical coating side of screen.
 - 1. Do not adhere tape to screen surface.
- C. Touch up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 11 52 16
AUDIO-VIDEO EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted television support.
- B. Cell Phone Charging Locker

1.02 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Assemblies.

1.03 SUBMITTALS

- A. Submit product data showing dimensions, finish, and accessories.
- B. Submit manufacturer's installation instructions indicating installation procedures and component installation sequence, clearances and tolerances from adjacent construction and maintenance.

1.04 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Shop Drawings.

1.05 COORDINATION

- A. Coordinate the work with ceiling construction.

1.06 FIRE CLASSIFICATION REQUIREMENTS

- A. ASTM E84: All materials shall have flame spread of less than 25 and smoke developed of less than 450.
- B. California Fire Code, Section 1103.3.3.
- C. NFPA 701- Standard Methods of Fire Tests Flame-Resistant Textiles and Films.
- D. FS 191A/5760 Mildew Resistant of Textile Materials.

1.07 REGULATORY REQUIREMENTS - DSA APPROVAL

- A. Manufacturer shall furnish Architect complete Shop Drawings and calculations as specified, certified and stamped by Structural Engineer currently licensed in California. Manufacturer shall employ and pay Engineer for Certification of Drawings and Calculations.
- B. Architect will submit drawings and calculations to the Division of the State Architect and approval prior to fabrication.

PART 2 - PRODUCTS

2.01 WALL TV/MONITOR MOUNT

- A. Description:

1. Mount shall be adjustable to accommodate multiple models of flat panel monitors of up to 160 lbs. in weight.
2. Compatibility:
 - a. Works with 26" to 85" diagonal monitors with standard VESA patterns (75x75, 100x100, 200x100 & 200mm x 200mm).
- B. Manufacturer: Premier Mounts.
 1. Contact: 130 E. Miraloma
 - a. Avenue Anaheim, CA 92806 USA
 - 1) (800) 832-4888 / www.mounts.com <<http://www.mounts.com/>>
 2. Single Source Responsibility: Provide like components and materials specified in this section from a single manufacturer.
- C. Model: Shall be Premier Mounts model #P2642F, P4263F or P5080F by display size or approved equivalent that will allow capacity of flat panel monitor.

2.02 CELL PHONE CHARGING LOCKER

- A. Basis of Design Product: Phone Charging Locker - Wall Mounted - 8 Bay as manufactured by Kwikboost, www.kwikboost.com, or approved equal.
- B. Configuration: Semi-Recessed
- C. Digital keypad locks with user generated codes
- D. Materials: Aluminum & steel
- E. Easy set up - works with standard outlet
- F. Product Specifications:
 1. Cables: 6 lightning, 6 micro, 4 type c; 5V, 2.4A per port
 2. Unit dimensions: 48"x24"x5"
 3. Unit weight: 50lbs

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to universal projector mount installation.
 1. Inform Consultant of unacceptable conditions immediately upon discovery.
 - a. Proceed with installation only after unacceptable conditions have been remedied.

3.02 PREPARATION

- A. Verify that mounting surface is capable of supporting a static load of four times the combined weight of the projector and the mount.
- B. Remove projector mount assembly contents from carton and verify that there are no damaged or missing parts.

- C. Surface Preparation: Prepare surface in accordance with manufacturer=s written recommendations.

3.03 INSTALLATION

- A. Coordinate installation of universal projector mount in accordance with construction details, manufacturer’s installation instructions and reviewed shop drawings at locations and heights indicated.
- B. Coordinate universal projector mount work with work of other trades for proper time and sequence to avoid construction delays.
- C. Install universal projector mount plumb and level to supporting substrate.
- D. Replace non-secure screws with security screws.
- E. Accurately fit, align, securely fasten and install free from distortion or defects.

3.04 ADJUSTING

- A. Adjust components and systems for correct function and operation in accordance with manufacturer=s written instructions.
 - 1. Verify that roll adjusts to plus or minus 20 degrees as designed and to meet project requirements.
 - 2. Verify that pitch adjusts to plus or minus 15 degrees as designed and to meet project requirements.
 - 3. Verify that mount operates with 360 degrees of swivel as designed and to meet project requirements

3.05 CLEANING

- A. Upon completion, remove surplus materials, rubbish, tools and equipment.
- B. Waste Management:
 - 1. Coordinate recycling of waste materials with section for Construction Waste Management and Disposal.
 - 2. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.
 - 3. Remove recycling containers and bins from site.

3.06 PROTECTION

- A. Protect installed product from damage during construction.
- B. Repair damage to adjacent materials caused by universal projector mount installation.

3.07 ADJUSTING, CLEANING AND PROTECTION

- A. Adjusting: Make required adjustments for smooth operation, free of binding, squeaking and unnecessary rattling.
- B. Cleaning: Clean exposed components prior to Acceptance.

- C. Protection: Protect audio-visual equipment mounts from unauthorized use, marring and soiling until Acceptance.

END OF SECTION

SECTION 12 24 00 WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Window shades and accessories.
- B. Contractor to provide concealed fascia integrated in finished ceilings, support backing for mounting, power, conduit, raceways and switchboxes.

1.02 RELATED REQUIREMENTS

- A. Section 08 43 13 - Aluminum Framed Storefronts: Substrate for window shade systems.
- B. Section 08 44 13 - Glazed Aluminum Curtain Walls: Substrate for window shade systems.
- C. Section 09 21 16 - Gypsum Board Assemblies: Substrate for window shade systems.
- D. Section 09 51 00 - Suspended Acoustical Ceilings: Shade Pockets, pocket closures and accessories.

1.03 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- B. CA Article 3.08, Title 19 - Title 19 California Code of Regulations, Subchapter 1, Article 3.08 Decorative Materials; current edition.
- C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.
- D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

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 all affected installers.
- C. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
- 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. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- J. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in District's name and registered with manufacturer.

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 and approved by manufacturer.
 - 1. Factory training and demonstrated experience.

1.07 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.

1.08 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: One year.
 - 2. Fabric: One year.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
 - 1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com: Kathy Greenway (951) 304-9286.
 - 2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
 - 3. Mechoshade; Mecho/5 pocket with fascia: www.mechoshade.com: Carlos Herrera (626) 369-7777.
 - 4. Skyco Shading; www.skycoshade.com: (714) 552-4064.
 - 5. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
- B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 WINDOW SHADE APPLICATIONS

- A. Interior Roller Shades: Privacy shades.
 - 1. Type: Roll down, closed position is at window sill.
 - 2. Fabric: As selected by Architect from manufacturer's full range.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.
 - 4. Mounting: Inside and outside, where indicated on drawings.
 - 5. Operation: Manual.
- B. Interior Roller Shades at Classrooms: Blackout shades with second shade in same opening.
 - 1. Type: Roll down, closed position is at window sill.
 - 2. Fabric: As selected by Architect from manufacturer's full range.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.
 - 4. Mounting: Inside and outside, where indicated on drawings.
 - 5. Operation: Manual.

2.03 ROLLER SHADES

- A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
 - 1. Drop: Regular roll.
 - 2. Size: As indicated on drawings.
- B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Privacy Shades: Soften the light yet still reveal some details to the outside; moderate privacy; Openness Factor approximately equal to 1 percent.
 - 2. Blackout Shades: Block virtually all the light; Openness Factor equal to zero (0).

3. Flammability: Pass NFPA 701 large and small tests. Comply with CA Article 3.08, Title 19.
 4. Fungal Resistance: No growth when tested according to ASTM G21.
- C. Roller Tubes: As required for type of operation.
1. Material: Extruded aluminum or galvanized steel; as required for shade location.
 2. Size: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
 3. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge or double sided adhesive tape.
 4. Finish: Clear anodized.
- D. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
1. Style: Half wrap fabric covered bottom bar, flat profile with closed ends.
 2. Finish: Painted.
 3. Color: As selected from manufacturer's standard colors.
 4. Blackout Shades: Provide a slot in bottom bar with wool-pile light seal.
- E. Manual Operation: Clutch operated continuous loop; beaded ball chain. Chain length shall extend below shade to 39 inches AFF.

2.04 ACCESSORIES

- A. Fascias: Size as required to conceal shade mounting.
1. Style: As selected by Architect from shade manufacturer's full selection.
 2. Material and Color: To match shade.
- B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.
- C. Interior Side Channels: As required for light sealing blackout shade applications.
- D. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.05 FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. 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 - Inside Mounting: Fill openings from jamb to jamb.
 3. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
 4. 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. Installation Tolerances:
 - 1. Inside Mounting: Maximum space between shade and jamb when closed of 1/16 inch.
 - 2. Maximum Offset From Level: 1/16 inch.
- C. Replace shades that exceed specified dimensional tolerances at no extra cost to District.
- D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Procedures, for closeout submittals.
- B. Demonstration: Demonstrate operation and maintenance of window shade system to District's personnel.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.07 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 12 36 00
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinetwork.
- B. Wall-hung counters.

1.02 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 09 21 16 - Gypsum Board Assemblies: Support framing, grounds, and concealed blocking.
- C. Division 22 - Plumbing: Sinks.

1.03 REFERENCE STANDARDS

- A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- G. PS 1 - Structural Plywood; 2009.
- H. WI (MCP) - Monitored Compliance Program (MCP); current edition at www.woodworkinstitute.com.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, 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. Installation Instructions: Manufacturer's installation instructions and recommendations.
- I. 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. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. 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.
 - 4. 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.
 - 5. 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. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Basis of Design Product: Solid Surface as manufactured by Formica, or approved equal.
 - b. Manufacturers:
 - 1) Avonite Surfaces: www.avonitesurfaces.com.
 - 2) Dupont: www.corian.com.
 - 3) Formica Corporation: www.formica.com.
 - 4) Wilsonart: www.wilsonart.com.
 - 5) Panolam Industries International, Inc.(Nevamar): www.nevamar.com.
 - 6) Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 - c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - d. NSF approved for food contact.
 - e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - f. Color and Pattern: As selected by Architect from manufacturer's full line.
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; bullnosed edge.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.

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.
- 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. Wall-Mounted Counters: Provide brackets and braces as indicated on drawings.
 - 1. Mounting: Inside wall to side of stud.
 - 2. Finish: As selected from the manufacturer's standard range.
 - 3. Counter Support Bracket: Unless indicated otherwise on Drawings.
 - a. Basis of Design Product: Inside Wall - Flush Mount or EH-1818 and 2 x 2 x 1/8 inch aluminium angle Cleat Stock as manufactured by Rakks/Rangine Corporation, rakks.com, or approved equal.

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. 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 48 13
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Extruded aluminum entrance floor grilles.

1.02 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data indicating properties of walk-off surface, component dimensions.
- C. Shop Drawings: Indicate dimensions.
 - 1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
- D. Samples: Submit two samples, 12 by 12 inch in size illustrating pattern, color, finish, and edging.
- E. Maintenance Data: Include cleaning instructions, and stain removal procedures.

1.03 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 five year manufacturer warranty for materials and workmanship .

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Entrance Floor Grilles and Gratings:
 - 1. Activar Construction Products Group: www.activarcpg.com/#sle.
 - 2. Babcock-Davis: www.babcockdavis.com/sle.
 - 3. Balco, Inc. : www.balcousa.com.
 - 4. Construction Specialties : www.c-sgroup.com.
 - 5. Nystrom, Inc: www.nystrom.com/sle.
 - 6. Pawling Corporation: www.pawling.com.
 - 7. Reese Enterprises, Inc: www.reeseusa.com.
 - 8. Substitutions: See Section 01 63 00 - Product Substitution Procedures.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

- A. Entrance Floor Grilles: Recessed extruded aluminum grille assembly with nominal 1 inch wide tread strips running perpendicular to traffic flow, slots between treads, and perimeter frame forming sides of recess; grille hinged for access to recess.

1. Basis of Design Product: Peditred G4 with recessed level base frame as manufactured by Construction Specialties, or approved equal.
 2. Recess Depth: 3/4 inches.
 3. Tread Surfaces: Alternating serrated anodized aluminum and nylon carpet.
 - a. HD – MonoTuft HD™ Carpet: To meet CRI standard for good indoor air quality.
 - b. Fibers: Include a minimum of 100, 12 mil monofilament fibers per square inch.
 - c. Fusion-bond each carpet fiber and monofilament to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths.
 - d. Provide anti-static carpet fibers to contain antimicrobial additive and be treated with Scotchgard® to reduce soiling.
 - e. Carpet Weight: 33-oz./yd².
 4. Colors: To be selected by Architect from manufacturer's full selection.
 5. Length in Direction of Traffic Flow: 72 inches.
 6. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
 7. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
 - a. LB - Level Base Frame: 1 inch (25.4mm) deep recessed frame in 6063-T6 aluminum alloy with a 1/4 inch (6.4mm) wide exposed surface.
 - b. Provide black EPDM filler trims as required, when standard 1-1/2 inch (38.1mm) tread spacing cannot be maintained.
 - c. Installer shall use recommended latex screed to ensure level base.
 8. Pan: Anodized aluminum bottom pan with drain, sealed to frame.
- B. Mounting: Top of non-resilient members level with adjacent floor.
- C. Structural Capacity: Capable of supporting a rolling load of 500 pounds without permanent deformation or noticeable deflection.
- D. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

2.03 FABRICATION

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.
- B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

- A. Mats: Verify size of floor recess before fabricating mats.
- B. Vacuum clean floor recess.

3.03 INSTALLATION

- A. Install frames to achieve flush plane with finished floor surface.
- B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

3.04 TOLERANCES

- A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch.

END OF SECTION

SECTION 14 24 00
HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Complete hydraulic elevator systems.
 - 1. Passenger type.
- B. Elevator Maintenance Contract.

1.02 RELATED REQUIREMENTS

- A. Project Type:
 - 1. Public
- B. Code agency:
 - 1. California Building Code
 - 2. DSA
- C. Section 03 30 00 - Cast-in-Place Concrete: Includes elevator machine foundation, enclosed hoistway, elevator pit, overhead hoist beams, grouting thresholds, and grouting hoistway entrance frames.
- D. Section 03 10 00 - Concrete Forming and Accessories: Execution requirements for placement of special guide rail brackets and inserts for casting in concrete.
- E. Section 05 12 00 - Structural Steel Framing: Includes hoistway framing, divider beams, and overhead hoist beams.
- F. Section 05 50 00 - Metal Fabrications: Includes elevator pit ladder, sill supports, divider beams, and overhead hoist beams.
- G. Section 07 72 00 - Roof Accessories: Smoke venting hatch at top of hoistway.
- H. Section 07 84 00 - Firestopping: Fire rated sealant in hoistway.
- I. Section 08 31 00 - Access Doors and Panels: Fire rated access doors into hoistway.
- J. Division 27 - Communications: Product requirements for card readers for placement by this section.
- K. Section 09 21 16 - Gypsum Board Assemblies: Gypsum shaft walls.
- L. Section 09 65 00 - Resilient Flooring: Floor finish in car.
- M. Section 09 91 23 - Interior Painting: Field painting of hoistway entrance doors and frames.
- N. Section 10 44 00 - Fire Protection Specialties: Fire extinguisher in elevator machine room.
- O. Section 21 13 13 - Wet-Pipe Sprinkler Systems: Sprinkler heads in hoistway.
 - 1. Per DSA Interpretation of Regulation IR 30-1, dated 11/3/10; a "side-wall" type of sprinkler installed a maximum of 2 feet above the bottom of the hoist way, but in no case shall the sprinkler be installed so as to be an obstruction to the elevator car at its lowest point of travel.
- P. Division 26- Electrical:

1. Conduit to elevator equipment devices remote from elevator machine room or hoistway.
 2. Conduit between controller cabinet in machine room to remote group supervisory panel in lobby.
 3. Electrical characteristics and wiring connections.
 4. Electrical service to main disconnect located in elevator machine room.
 5. Emergency power transfer cabinet.
 6. Electrical power for elevator installation and testing.
 7. Electrical disconnecting device to elevator equipment prior to activation of sprinkler system.
 8. Electrical service for machine room, convenience outlets, and elevator pit.
 9. Lighting in elevator pit.
 10. Conduit for telephone service to location(s) as indicated on drawings.
- Q. Division 26, 27, & 28: General requirements and basic electrical materials and methods for electrical work; applies to elevator work, except more stringent requirements specified herein and requirements of governing authorities shall take precedence.
- R. Section 28 46 20 - Fire Alarm:
1. Fire and smoke detectors and interconnecting devices.
 2. Fire alarm signal lines to elevator controller cabinet.
 3. Per DSA Interpretation of Regulation IR 30-1, dated 11/3/10; Smoke or Heat Detection is not required at the top of the elevator hoistway if there is no automatic fire sprinkler located at the top of the hoistway.
- S. Section 31 20 00 - Earthwork: Excavation for cylinder casing, hydraulic lines, and remote machine room.
- T. Section 31 20 00 - Earthwork: Backfilling for hydraulic lines and remote machine room.

1.03 REFERENCE STANDARDS

- A. 28 CFR 35 - Structural Sealant Glazing Systems; 1985 (R2006).
- B. ACI 308R - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- D. AISC 360 - Specification for Structural Steel Buildings; 2010.
- E. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- G. ASME A17.1 - Safety Code for Elevators and Escalators; 2013.
 1. Use 2013, as indicated in CBC 2016 Referenced Standards.
- H. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks; 2014.
- I. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors; 2013.

- J. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- K. ASTM A139/A139M - Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over); 2016.
- L. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- M. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
 - 1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- O. ITS (DIR) - Directory of Listed Products; current edition.
- P. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- Q. NEMA MG 1 - Motors and Generators; 2014.
- R. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
 - 1. Use 2016 as modified in 2016 CBC Referenced Standards.
- S. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - 1. Use 2014 as modified in 2016 CBC Referenced Standards.
- T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
 - 1. Use 2016 as modified in 2016 CBC Referenced Standards.
- U. PS 1 - Structural Plywood; 2009.
- V. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- W. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other installers to provide conduits necessary for installation of wiring including but not limited to:
 - a. Elevator equipment devices remote from elevator machine room or hoistway.
 - b. Remote group automatic panel in lobby from controller cabinet.
 - c. Telephone service for machine room.
 - d. To elevator pit for lighting.
 - e. Automatic transfer switch from controller cabinet.
 - f. Fire alarm panel from controller cabinet.
 - 2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to, the following:
 - a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
 - b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation.
 - c. Overcurrent protection devices selected to achieve required selective coordination.

- B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
 - 1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
- C. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit data on following items:
 - 1. Signal and operating fixtures, operating panels, and indicators.
 - 2. Car design, dimensions, layout, and components.
 - 3. Car and hoistway door and frame details.
 - 4. Electrical characteristics and connection requirements.
- C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
 - 1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
 - a. Include motors and hydraulic pumps, valves, controller, motor generator, selector, governor and other components; conform to regulatory requirements; note all variances from Drawings and all violations of clearance and location requirements of authorities having jurisdiction.
 - b. Include electrical panels and switches along with their clearance requirements.
 - 1) Location of circuit breaker, switchboard panel or disconnect switch, light switch and feeder extension points in machine room.
 - 2. Hoistway Components: Size and location of car guide rails, buffers, jack unit and other components.
 - a. Minimum required hoistway dimensions and required clearances, including width, depth and height. Indicate field-measured dimensions and note all violations of clearances required by authorities having jurisdiction.
 - 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
 - a. Provide a separate guide rail only, submittal package for deferred approval by the Division of the State Architect.
 - 1) Include only the guide rails and their related connections to the structure as noted below.
 - 2) Provide minimum 8 copies. Four of these copies shall be wet signed by the Structural Engineer responsible for the Shop Drawings.
 - 3) Submit to Architect within 60 days of Notice to Proceed.
 - 4) All corrections shall be completed without revision marks. Provide narrative of changes separate from drawings.
 - 4. Individual weight of principal components; load reaction at points of support.
 - 5. Clearances and over-travel of car.

6. Locations in hoistway and machine room of traveling cables and connections for car lighting and telephone.
 7. Location and sizes of hoistway and car doors and frames.
 8. Calculated heat dissipation of elevator equipment in machine room.
 9. Applicable seismic design data; certified by a licensed Professional Structural Engineer.
 10. Interface with building security system.
 11. Electrical characteristics and connection requirements.
 12. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
- D. Samples: Submit samples illustrating car interior finishes, car and hoistway door and frame finishes, and handrail material and finish in the form of cut sheets or finish color selection brochures.
 - E. Manufacturer's Qualification Statement.
 - F. Installer's Qualification Statement.
 - G. Testing Agency'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. Initial Maintenance Contract.
 - J. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
 1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
 - K. Operation and Maintenance Data:
 1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
 2. Operation and maintenance manual.
 3. Schematic drawings of equipment and hydraulic piping, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of each quality standard document on site.
- B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in California.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- D. Installer Qualifications: Trained personnel and supervisor on staff of elevator equipment manufacturer.

- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
- F. Products Requiring Fire Resistance Rating: Listed and classified by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

1.07 REGULATORY REQUIREMENTS

- A. California Elevator Safety Construction Code, California Code of Regulations, Title 24, Part 7.
 - 1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition.
- B. NFPA 70 National Electrical Code.
- C. NFPA 80 Fire Doors and Windows.
- D. ADA Standards.
- E. California Building Code (CBC) Part 2, Chapter 30 for Elevators and Chapter 11B for accessibility.
 - 1. Every passenger elevator shall comply with CBC Section 11B-407.
 - 2. Provide a two-way communication system with both audible and visible signals at the elevator landing on each accessible floor that is one or more stories above or below the story of exit discharge per CBC Section 1007.8.
 - 3. Provide a directional signage at elevator landings indicating the locations of the other means of egress and which are accessible means of egress per CBC Section 1007.10.
- F. All elevators shall comply with all of the requirements of CBC section 11B-206.6.
 - 1. Passenger elevators shall be located near a major path of travel and provisions shall be made to ensure that they remain accessible and usable at all times the building is occupied. CBC 11B-402.2 and 11B-108.
 - 2. Operating and Leveling: The elevator shall be automatic and provided with a self-leveling feature that will automatically bring the car to the floor landings within a tolerance of plus or minus 1/2 inch under rated loading to zero loading conditions; CBC 11B-407.4.4.
 - a. The clearance between the car platform sill and the edge of the hoist-way landing shall be no greater than 1-1/4 inch; CBC 11B-407.4.3.
 - 3. Door Operation: Sliding type only; CBC 11B-407.3.1.
 - a. Door width tolerance: minus 5/8 inch per footnote 1.
 - 4. Door Size: Minimum door clear width for elevator doors shall be per CBC 11B-407.3.6 and Table 11B-407.4.1.
 - a. Door Location:
 - 1) Centered Door Clear Width: 42 inches.
 - 2) Side Door Clear Width: 36 inches.
 - b. Door width tolerance: minus 5/8 inch per footnote 1.
 - 5. Door Protective and Reopening Device:

- a. Elevator doors shall be provided with a reopening device complying with Section 11B-407.3.3 that shall stop and reopen a car door and hoistway door automatically if the door becomes obstructed by an object or person.
 - b. The device shall be activated by sensing an obstruction passing through the opening at 5 inches nominal and 29 inches nominal above the finish floor. CBC 11B-407.3.3.1.
 - c. The device shall not require physical contact to be activated, although contact is permitted to occur before the door reverses. CBC 11B-407.3.3.2
 - d. Door reopening devices shall remain effective for 20 seconds minimum. After such an interval, the doors may close in accordance with the requirements of ASME A17.1. CBC 11B-407.3.3.3.
6. Hall Call:
- a. The minimum acceptable time from notification that a car is answering a call or notification of the car assigned at the means for the entry of destination information until the doors of that car start to close shall be calculated from the following equation: CBC 11B-407.3.4
 - 1) $T = D/(1.5 \text{ ft/s})$ or $T = D/(455 \text{ mm/s}) = 5$ seconds minimum where T equals the total time in seconds and D equals the distance (in feet or millimeters) from the point in the lobby or corridor 60 inches directly in front of the farthest call button controlling that car to the centerline of its hoistway door.
7. Car Call (Door Delay): Elevator doors shall remain fully open in response to a car call for 5 seconds minimum. CBC 11B-407.3.5.
8. Car Inside Dimensions: CBC Table 11B-407.4.1
- a. Accessibility: The car inside shall allow for the turning of a wheelchair.
 - 1) Inside car side to side:
 - (a) Centered Door: 80 inches.
 - (b) Side Door: 68 inches.
 - 2) Inside car back wall to front return:
 - (a) Centered Door: 51 inches.
 - (b) Side Door: 51 inches.
 - 3) Inside car back wall to inside face of door:
 - (a) Centered Door: 51 inches.
 - (b) Side Door: 51 inches.
9. Car Controls: CBC 11B-407.4.6 and 11B-309.4.
- a. Location:
 - 1) The centerline of elevator floor buttons shall be no higher than 48 inches. CBC 11B-308.2.1.
 - (a) At elevators with side approach and more than 16 stops the elevator floor buttons shall be no higher than 48 inch above the finish floor. CBC 11B-407.4.6.1, Exception 1.
 - 2) Emergency controls, including the emergency stop and alarm, shall be grouped in or adjacent to the bottom of the panel and shall be no lower than 35 inches from the floor. (11B-407.6.1)
 - b. Buttons: Comply with CBC 11B-407.4.6.2.

- c. Emergency controls: CBC 11B-407.4.6.4.
 - 1) Height: Emergency control buttons shall have their centerlines 35 inches minimum above the finish floor. CBC 11B-407.4.6.4.1
 - 2) Location. Emergency controls, including the emergency alarm, shall be grouped at the bottom of the panel. CBC 11B-407.4.6.4.2
- 10. Emergency two-way communication systems shall comply with Section 11B-308. Raised symbols or characters, white on a black background, and Braille shall be provided adjacent to the device and shall comply with Sections 11B-703.2 and 11B-703.3. CBC 11B-407.4.9
 - a. Emergency two-way communication systems between the elevator and a point outside the hoistway shall comply with ASME A17.1
 - b. If the telephone system is located in a closed compartment, the compartment door hardware shall be lever type conforming to the provisions of CBC 1008.1.9.1.
- 11. Audible and visible car position indicators shall be provided in elevator cars. CBC 11B-407.4.8.
- 12. Handrails: A support shall be provided on one wall of the car, preferably the rear. CBC 11B-407.4.10.
 - a. The rails shall be smooth, any surface adjacent to them shall be free of sharp or abrasive elements. CBC 11B-407.4.10.2.
 - b. Inside surface at least 1-1/2 inches clear of the walls. CBC 11B-407.4.10.1.
 - c. Nominal height to top of support rail: 31 inches minimum to 33 inches maximum from the floor. CBC 11B-407.4.10.1.
 - d. Maximum distance from adjacent walls: 6 inches CBC 11B-407.4.10.1.
- 13. Illumination level at the car controls, platform, car threshold and car landing sill shall be 5 foot candles (54 lux) minimum. CBC 11B-407.4.5.
- 14. Hall Call buttons: Where elevator call buttons or keypads are provided, they shall comply with CBC 11B-407.2.1 and 11B-309.4.
- 15. Hall Signals: Hall signals, including in-car signals, shall comply with CBC 11B-407.2.2.
 - a. A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call and the car's direction of travel. Where in-car signals are provided, they shall be visible from the floor area adjacent to the hall call buttons. CBC 11B-407.2.2.1.
 - b. Visible signal fixtures shall be centered at 72 inches minimum above the finish floor or ground. The visible signal elements shall be a minimum 2-1/2 inches high by 2-1/4 inches wide. Signals shall be visible from the floor area adjacent to the hall call button. CBC 11B-407.2.2.2 and figure 11B-407.2.2.2.
 - c. Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that indicate the direction of elevator car travel. Audible signals shall have a frequency of 1500 Hz maximum. Verbal annunciators shall have a frequency of 300 Hz minimum and 3000 Hz maximum. The audible signal and verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the hall call button. CBC 11B-407.2.2.3.

16. Floor Designation (Door Jamb Marking): Floor designations complying with Sections 11B-703.2 and 11B-703.4.1 shall be provided on both jambs of elevator hoistway entrances. CBC 11B-407.2.3.1 and figure 11B-407.2.3.1.
 - a. Floor designations shall be provided in both raised characters and Braille. Raised characters shall be 2 inches high.
 - b. A raised star, placed to the left of the floor designation, shall be provided on both jambs at the main entry level.
 - 1) The outside diameter of the star shall be 2 inches and all points shall be of equal length.
 - c. Raised characters, including the star, shall be white on a black background. Braille complying with Section 11B-703.3 shall be placed below the corresponding raised characters and the star.
 - d. The Braille translation for the star shall be "MAIN".
 - e. Applied plates are acceptable if they are permanently fixed to the jamb.
17. Provide a direction signage at elevator landings indicating the locations of the other means of egress and which are accessible means of egress per CBC 1007.10.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design - Hydraulic Elevators: Mitsubishi Elevator; www.mitsubishielevator.com.
- B. Substitutions: See Section 01 63 00 - Product Substitution Procedures.
 1. For any product not identified as Basis of Design, submit information as specified for substitutions.
- C. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- D. Source Limitations: Provide elevator and associated equipment and components produced by a single manufacturer and obtained from a single supplier .

2.02 HYDRAULIC ELEVATORS

- A. Hydraulic Passenger Elevator, No. 1:
 1. Hydraulic Elevator Equipment:
 - a. Hydraulic with cylinder in buried casing below elevator pit.
 2. Operation Control Type: Single Automatic (Push Button) Operation Control.
 3. Interior Car Height: 96 inch.

4. Electrical Power: 480 volts; alternating current (AC); three phase; 60 Hz.
5. Rated Net Capacity: 4000 lbs.
6. Rated Speed: 150 ft per minute.
7. Hoistway Size: 114 inch wide by 83 inch deep.
8. Interior Car Platform Size: 92 inch wide by 64-3/4 inch deep.
9. Elevator Pit Depth: 48 inch.
10. Overhead Clearance at Top Floor: 156 inch.
11. Travel Distance: As indicated on drawings.
12. Number of Stops: As indicated on drawings.
13. Number of Openings: 3 Front.

2.03 COMPONENTS

A. Elevator Equipment:

1. Motors, Hydraulic Equipment, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Conform to NFPA 70. Refer to Section 877. Controller to be non-proprietary.
2. Guide Rails, Cables, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
3. Buffers:
 - a. Spring type for elevators with speed less than or equal to 200 feet per minute.
4. Lubrication Equipment:
 - a. Lubrication Points: Visible and easily accessible.

B. Electrical Equipment:

1. Motors: NEMA MG 1.
2. Boxes, Conduit, Wiring, and Devices: As required by CEC (NFPA 70.)
3. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
4. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. Refer to Division 26.

2.04 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
- D. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
 1. Complying with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7 and other related requirements.

- a. Project Seismic Risk: As indicated on drawings.
- 2. Provide earthquake emergency operations in accordance with ASME A17.1 requirements.
- 3. Seismic Criteria: Design and assemble components to withstand earthquake forces in accordance with California Building Code (CBC), Title 24 Part 1 and Title 24 Part 2, Section 1613A and other applicable regulatory requirements. Include adjustable seismic trigger switches to operate elevators whenever predetermined level of seismic acceleration is detected:
 - a. Prevent idle elevators from starting.
 - b. Stop elevators at next available stop.
- E. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- F. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.
- G. Perform electrical work in accordance with NFPA 70.
- H. Comply with venting or pressurization of hoistway design in accordance with HVAC system requirements and authorities having jurisdiction (AHJ).
- I. Comply with fire protection sprinkler system of hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction (AHJ). Refer to Section 21 13 13.

2.05 OPERATION CONTROLS

- A. Elevator Controls: Provide landing operating panels and landing indicator panels.
 - 1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
 - 2. Landing Indicator Panels: Illuminating.
 - 3. Comply with ADA Standards for elevator controls.
- B. Interconnect elevator control system with building security, fire alarm, and smoke alarm systems.
- C. Door Operation Controls:
 - 1. Program door control to open doors automatically when car arrives at floor landing.
 - 2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
 - 3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.
- D. Provide "Firefighter's Emergency Operation" in accordance with ASME A17.1, applicable building codes, and authorities having jurisdiction (AHJ).
 - 1. Designated Landing: As indicated on drawings.

2.06 OPERATION CONTROL TYPE

- A. Single Automatic (Push Button) Operation Control: Applies to car in single elevator shaft.
 - 1. Refer to description provided in ASME A17.1.

2. Set system operation so that momentary pressure of landing button dispatches car from other landing to that landing.
3. Allow call registered by momentary pressure of landing button at any time to remain registered until car stops in response to that landing call.
4. If elevator car door is not opened within predetermined period of time after car has stopped at terminal landing allow car to respond to call registered from other landing.

2.07 SERVICE CONTROL TYPE

2.08 EMERGENCY POWER

- A. Set-up elevator operation to run with elevator emergency power supply when the normal building power supply fails, and in compliance with ASME A17.1 requirements.
- B. Elevator Emergency Power Supply: Supplied by battery backup; provide elevator system components as required for emergency power characteristics.
- C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
- D. Provide operational control circuitry for adapting the change from normal to emergency power.
- E. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

2.09 MATERIALS

- A. Steel Cylinder Casing: ASTM A139/A139M, Grade A steel.
- B. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.
- C. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
- D. Plywood: PS 1, Structural I, Grade C-D or better, sanded.
- E. Tempered Glass: 3/8 inch minimum thickness, fully tempered in compliance with ASME A17.1, 28 CFR 35, ANSI Z97.1, and ASTM C1048 tempered glass requirements.
- F. Resilient Flooring: Vinyl tile flooring, as specified in Section 09 65 00, Type ____.
- G. Plastic Laminate: NEMA LD 3, Type HGS, color as selected by Architect from manufacturer's standard line of colors.

2.10 CAR AND HOISTWAY ENTRANCES

- A. Elevator, No. 1:
 1. Car and Hoistway Entrances, Each Elevator Floor Lobby:
 - a. Framed Opening Finish and Material: Brushed stainless steel, #4.
 - b. Car Door Material: Stainless steel #4, with rigid sandwich panel construction.
 - c. Hoistway Door Material: Stainless steel #4, with rigid sandwich panel construction.
 - d. Door Type: Double leaf.
 - e. Door Operation: Center opening, single speed.
 - f. Door Width: 42 inch.
 - g. Door Height: 84 inches.
 - h. Sills: Manufacturer's standard.

- B. Sills/Thresholds: Configure to align with frame return and coordinate with floor finish.
- C. Gasketing: Provide acoustic type gasketing at hoistway doors and frames to eliminate audible noise due to car activities in the hoistway, and air pressure differential between hoistway and landing floors.

2.11 CAR EQUIPMENT AND MATERIALS

A. Elevator Car:

1. Car Operating Panel: Provide main; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
 - a. Panel Material: Integral with front return; one per car.
 - b. Car Floor Position Indicator: Above door with illuminating position indicators.
 - c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch above car finished floor.
2. Ventilation: Single speed fan with grille in ceiling.
3. Flooring: Resilient vinyl tile.
4. Wall Base: As indicated on Drawings, "X" inch high.
5. Front Return Panel: Match material of car door.
6. Door Wall: As indicated on Drawings.
7. Side Walls: As indicated on Drawings.
8. Rear Wall: As indicated on Drawings.
9. Hand Rail: Stainless steel, at rear wall. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
 - a. Round, Metal Tube: 1-1/2 inch diameter.
 - b. Stainless Steel Finish: No. 4 Brushed.
10. Ceiling:
 - a. Canopy Ceiling: As indicated on Drawings.
 - b. Lighting: As selected from manufacturer's standard line.
11. Provide emergency access panel for egress from car at ceiling.

B. Car Accessories:

1. Certificate Frame: Stainless steel frame glazed with tempered glass, and attached with tamper-proof screws.
2. Protective Pads: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for service elevators only.
 - a. Provide at least 4 inch clearance from bottom of pad to finished floor.
 - b. Pad Supports: Stainless steel studs, and mounted from ceiling frame.

2.12 MACHINE ROOM FITTINGS

- A. Wall-Mounted Frames: Glazed with clear plastic; sized as required. Provide one chart each for master electric and hydraulic schematic and for lubrication chart. Install charts.
- B. Key Cabinet: Wall-mounted, lockable, keyed to building keying system, for control and operating panel keys.
 - 1. Provide two key cabinet keys.
 - 2. Provide two control/operating panel keys.
 - 3. Provide two card access keys.
- C. Monitoring Device Interface:
 - 1. Fabricate one multiple terminal block in controller relay panel or selector, in location indicated, for connection of monitoring devices for:
 - a. Landing and car registration circuits.
 - b. Motor generator running circuits.
 - c. Load weighing circuits.
 - d. Up and down peak programming circuits.
 - e. Independent service switches.
 - 2. Label terminals for use with alligator test clips.

2.13 FINISHES

- A. Field Painting: Comply with requirements as specified in Section 09 91 23.
- B. Powder Coat on Steel: Clean and degrease metal surface; apply one coat of primer; two coats of powder coat.
- C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction (AHJ).
- D. Finish Paint for Metal Surfaces: Alkyd enamel, semi-gloss, color as selected, complying with VOC limitations of authorities having jurisdiction (AHJ).
- E. Clear Anodized Finish: Class I, ACI 308R AA-M12C22A41 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils, 0.0007 inch thick.
- F. Color Anodized Finish: Class I, ACI 308R AA-M12C22A44 electrolytically deposited colored anodic coating not less than 0.7 mils, 0.0007 inch thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that hoistway, pit, and machine room are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components, and comply with requirements of Section 01 50 00 - Temporary Facilities and Controls.
- B. Excavate for in-ground hydraulic cylinder casing in accordance with Section 31 20 00, and remove subsoil from site.
- C. Maintain in-ground shaft alignment of 1/2 inch maximum from plumb.
 - 1. Fill over-excavated shaft depth with lean concrete.
- D. Maintain elevator pit excavation free of water.
- E. Maintain in-ground elevator shaft excavation free of water.
- F. Place in-ground plunger casing full depth of shaft. Align to 1/4 inch from plumb. Cut top of casing at hoistway pit slab elevation.
- G. Backfill around in-ground cylinder casing in accordance with Section 31 20 00.

3.03 INSTALLATION

- A. Coordinate this work with installation of hoistway wall construction.
- B. Install system components, and connect equipment to building utilities.
- C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Division 26.
- D. Install hydraulic piping between cylinder and pump unit.
- E. Mount machines, motors, and pumps on vibration and acoustic isolators, on bed plate and concrete pad.
 - 1. Securely fasten to building supports.
 - 2. Prevent lateral displacement.
- F. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
- G. Install guide rails to allow for thermal expansion and contraction movement of guide rails.
- H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
- I. Bolt or weld brackets directly to structural steel hoistway framing.
- J. Field Welds: Chip and clean away oxidation and residue with wire brush; spot prime surface with two coats.
- K. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
- L. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- M. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
- N. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
- O. Adjust equipment for smooth and quiet operation.

3.04 TOLERANCES

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
- B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control, for additional requirements.
- B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI-1 will be performed at their discretion.
 - 1. Schedule tests with agencies and notify District and Architect.
 - 2. Obtain permits as required to perform tests.
 - 3. Document regulatory agency tests and inspections in accordance with requirements.
 - 4. Perform tests required by regulatory agencies.
 - 5. Furnish test and approval certificates issued by authorities having jurisdiction.
- C. Perform testing and inspection in accordance with requirements.
 - 1. Inspectors shall be certified in accordance with ASME QEI-1.
 - 2. Perform tests as required by ASME A17.2.
 - 3. Provide at least two weeks written notice of date and time of tests and inspections.
 - 4. Supply instruments and execute specific tests.
- D. Operational Tests:
 - 1. Perform operational tests in the presence of District and Architect.
 - 2. At an agreed time, and the building occupied with normal building traffic, conduct tests to verify performance.
 - a. Furnish event recording of each landing call registrations, time initiated, and response time throughout entire working day.
 - 3. Set period of time elevator takes to travel between typical floor landings at not more than 35 seconds.
 - a. Measure time from moment doors start to close until car has stopped level at next floor landing and doors are opening.

3.06 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
- B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.07 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components in accordance with manufacturers written instructions.
 - 1. Polish metal work.

2. Clean elevator hoistway, pit and machine rooms, leaving floors without dust, residue, grease and oil. Clean exposed surfaces of equipment and components.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Procedures, for closeout submittals.
- B. Demonstrate proper operation of equipment to District's designated representative.
- 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, cleaning and maintenance of each component.
- D. Training: Train District's personnel on cleaning and 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 of training.
 3. Instructor: Manufacturer's training personnel.
 4. Location: At project site, unless noted otherwise.

3.09 PROTECTION

- A. Do not permit construction traffic within car after cleaning.
- B. Protect installed products until Date of Substantial Completion.
- C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

3.10 MAINTENANCE

- A. Refer to Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to initial maintenance service.
- B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 12 months from Date of Substantial Completion.
- C. Submit proposal for continuation of Maintenance Contract in accordance with ASME A17.1 and requirements as indicated for installed elevator equipment.
- D. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.
- E. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of District.
- F. Examine system components bi-monthly.
- G. Include systematic examination, adjustment, and lubrication of elevator equipment.
- H. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
- I. Perform work without removing cars from use during peak traffic periods.

- J. Provide emergency call back service on overtime throughout period of this maintenance contract.
- K. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION

Compton College New Student Services Building

tBP Project No. 20987.00

DSA #3 - 119686

File #

Bid No:

Compton College
Compton, California

PROJECT MANUAL

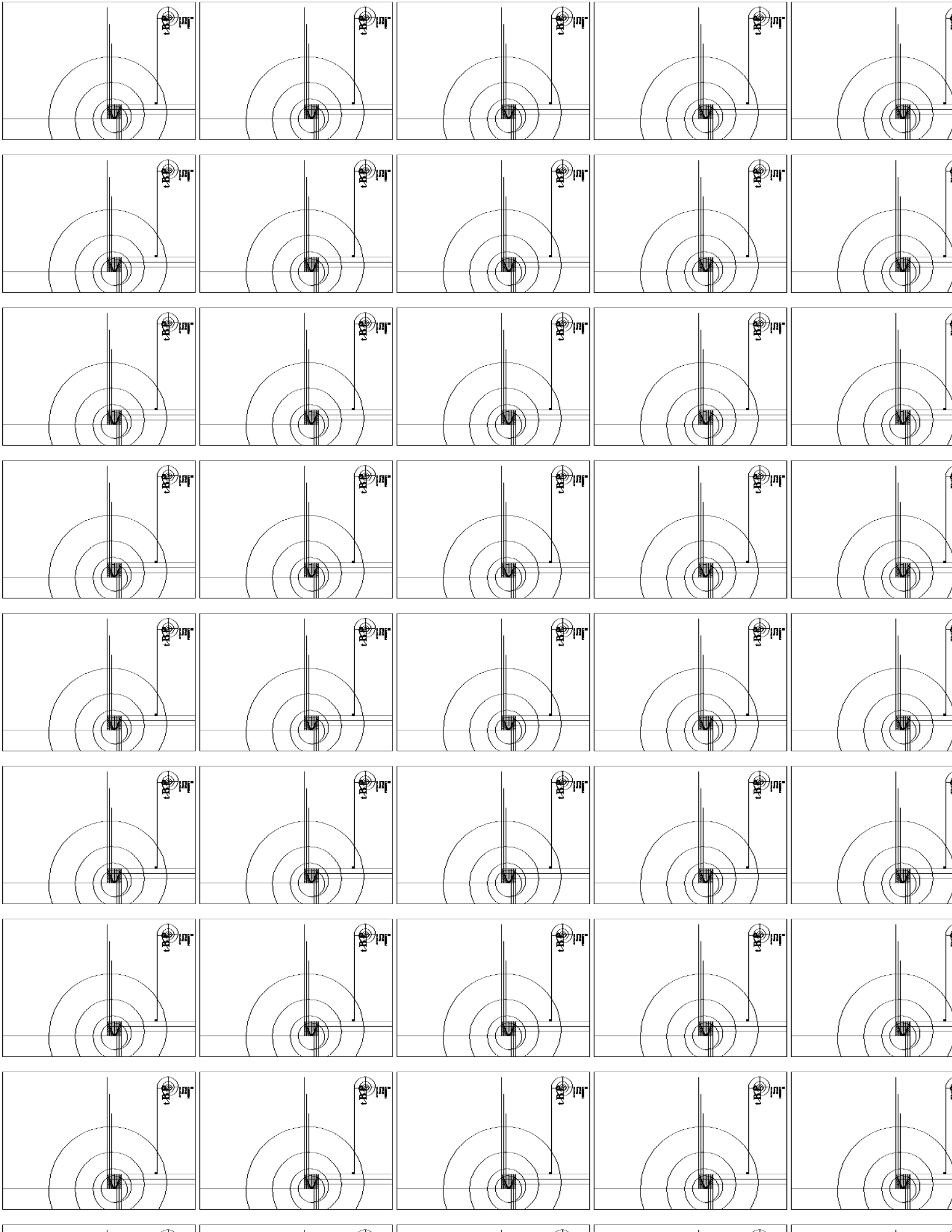
Volume 2 of 2
Divisions 21 - 33
September 2019

Architect:

tBP/Architecture
4611 Teller Ave. Newport Beach, CA 92660-2104
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tBP

Architecture
Planning
Interiors
Management



**SECTION 00 01 01
PROJECT TITLE PAGE
PROJECT MANUAL**

FOR

NEW STUDENT SERVICES BUILDING

PROJECT NUMBER: 20987.00

DISTRICT

**COMPTON COMMUNITY COLLEGE DISTRICT
1111 E. ARTESIA BOULEVARD, COMPTON CA 90221
310.900.1600
WWW.COMPTON.EDU**

PROJECT LOCATION

**COMPTON COLLEGE
1111 E. ARTESIA BOULEVARD
COMPTON , CALIFORNIA 90221**

PREPARED BY:

ARCHITECT

TBP/ARCHITECTURE, INC.

4611 Teller Avenue, Newport Beach, CA 92660
949.673.0300
www.tbparchitecture.com

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END OF PROJECT TITLE PAGE

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PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all Division 21 Sections.

1.02 RELATED REQUIREMENTS

- A. This Section is part of each Division 21 Section.

1.03 ADDITIONAL REQUIREMENTS

- A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.
- B. Make temporary connections required to maintain services during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before interrupting services.

1.04 REFERENCES AND STANDARDS

- A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at time of bid shall be used.
 - 1. ANSI - American National Standards Institute.
 - 2. ASTM - American Society for Testing and Materials.
 - 3. CCR - California Code of Regulations.
 - a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36.
 - 4. NCPWB - National Certified Pipe Welding Bureau.
 - 5. CEC - California Electrical Code.
 - 6. NEMA - National Electrical Manufacturers' Association.
 - 7. NFPA - National Fire Protection Association, as amended by the CBC.
 - 8. OSHA - Occupational Safety and Health Act.
 - 9. UL - Underwriters' Laboratories, Inc.
- B. Requirements of Regulatory Agencies:
 - 1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
 - 2. Code editions shall be as noted on Drawings, as adopted by the California Division of the State Architect (DSA).
 - a. California Building Code.
 - b. California Electrical Code.
 - c. California Energy Code.

- d. California Fire Code.
 - e. California Green Building Standards Code.
 - f. California Mechanical Code.
 - g. California Plumbing Code.
 - h. California Code of Regulations, Title 24.
 - i. California Health and Safety Code.
 - j. CAL-OSHA.
 - k. California State Fire Marshal, Title 19 CCR.
 - l. National Fire Protection Association.
 - m. Occupational Safety and Health Administration.
 - n. Other applicable state laws.
3. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:

1. It is expected that the Project shall progress according to the following sequence of events:
 - a. Upon award of bid, Contractor shall begin preparing coordination drawings. Refer to Coordination Article.
 - b. Completed coordination drawings shall be submitted to Architect for review. Refer to Submittals Article.
 - c. Engineer will determine need for Project re-submittal to DSA:
 - 1) No DSA re-submittal required: Coordination drawings will be returned to Contractor with comments noted and Contractor shall proceed with fabrication and erection of system in accordance with Contract Documents and reviewed submittal.
 - 2) DSA re-submittal required: Engineer will incorporate changes depicted in coordination drawings into Contract Drawings and hydraulic calculations for re-submittal to DSA. Upon DSA approval of re-submittal, Contractor shall proceed with fabrication and erection of system in accordance with modified Contract Documents.
 - d. Contractor shall issue Request for Information (RFI) for each field change required after approval of coordination drawings or approval of DSA re-submittal has been obtained. Contractor shall not proceed with changes prior to RFI response.
 - e. Contractor shall inform Architect immediately if deviating from this sequence of events.
2. The coordination process may not be used to redesign an automatic fire sprinkler system by the Contractor. Only those changes required for coordination with the work of other trades will be allowed.

B. Coordination:

1. Coordinate Work in this Section with trades covered in other Sections of Specifications to provide a complete and operable installation of highest quality workmanship.
2. Coordinate location of fire protection piping, mains and branches, to avoid interference with work by other trades. Plumbing drainage piping and ductwork shall have right-of-way over fire protection piping. Wherever conflicts exist, fire protection piping shall be offset or rerouted at no additional cost to Owner.
3. Piping shall be concealed, except where so indicated or where absolutely necessary to be exposed. Exposed piping shall be placed as approved by Architect prior to installation. Heads shall be fully coordinated with architectural reflected ceiling plan and placed in center of ceiling tiles.
4. On-site measurement of pipe will be required. Offsets, pipe, fittings, drains, etc., required to meet job conditions shall be furnished and installed at no extra cost to Owner.
5. Additional heads required by NFPA 13 regulations shall be provided at no extra cost, if required as a result of Contractors' coordination. Location of heads and mains shall not be changed unless approved by Architect.
6. Coordinate layout and installation of sprinklers with other construction penetrating ceilings, including light fixtures, HVAC equipment, and partition assemblies.
7. The Architect shall decide any differences or disputes concerning coordination, interference or extent of work, and his decision shall be final.
8. Contract Drawings are schematic. Rerouting of pipe and the addition, deletion or relocation of sprinkler heads may be necessary. Contractor shall prepare coordination drawings documenting changes. Contractor shall not proceed with fabrication or installation of fire protection system prior to approval of coordination drawings by Architect.
 - a. Re-submittal of revised Contract Drawings and calculations to DSA will be required when changes to the system design, made during Project coordination phase, alter parameters used in calculations furnished to DSA for permitting purposes. If re-submittal to DSA is required, mechanical Engineer shall prepare revised Drawings and hydraulic calculations. Contractor shall not proceed with fabrication or installation of fire protection system prior to approval of revised calculations by DSA.
 - b. Contractor-proposed changes to supports, anchorages, and seismic restraints for fire protection system shall conform to the following.
 - 1) Calculations performed for use in selection of supports, anchorages, and seismic restraints shall utilize criteria indicated in Structural Contract Documents.
 - 2) Supports, anchorage and seismic restraints for piping and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, Mason, or equal. Pipes and equipment shall be seismically restrained in accordance with requirements of current editions of California Building Code and NFPA 13. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by

the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping and restraint locations.

- a) Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.
- 3) In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, equipment, and restraint locations, and detailing supports, attachments and restraints. Furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with California Building Code, and NFPA 13.
- 4) Additional Requirements: In addition to the above, conform to State and local requirements.

1.06 DRAWINGS

- A. Examine Contract Documents prior to bidding of Work and report discrepancies in writing to Architect.
- B. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.
- C. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The fire protection Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
 1. Architectural and structural Drawings are part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over fire protection Drawings.
 2. Because of the small scale of fire protection Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in locations shown. Obtain Architects' approval prior to relocation of equipment and materials.
 3. Relocate equipment and materials installed without prior approval of Architect. Remove and relocate equipment and materials at Contractors' expense upon Architects' direction.
 4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.

- D. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.07 FEES AND PERMITS

- A. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with the requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
 - 1. Contractor shall bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.

1.08 SUBMITTALS - GENERAL

- A. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used. Refer to Division 01 Specifications for complete instructions.
 - 1. Partial or incomplete submittals will not be reviewed.
 - 2. Quantities are Contractor's responsibility and will not be reviewed.
 - 3. Provide materials of same brand or manufacturer for each class of equipment or material.
 - 4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
 - 5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
 - 6. Organize submittals in same sequence as in Specification Sections.
 - 7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
 - a. Submit shop drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
 - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
 - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.

- d. Catalog cuts and published material may be included with supplemental scaled drawings.
- B. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.
- C. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.
 - 1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Contract Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from Contract Documents shall be clearly identified and appear at the beginning of submittal package, and shall be referenced to applicable Contract Documents requirements.
- D. Furnish to Project Inspector complete installation instructions on material and equipment before starting installation.
- E. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

1.09 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for fire protection systems materials and products.
- B. Shop Drawings.
- C. Provide product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

1.10 INFORMATIONAL SUBMITTALS

- A. Provide layouts for fire protection systems, for inclusion in coordinated layout specified in Section 23 31 13, "Metal Ducts." Comply with requirements for layouts specified in Section 23 31 13.
- B. Provide coordination drawings for fire protection systems in accordance with the requirements of Specification Section 21 13 13, "Wet-Pipe Sprinkler Systems."

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

1. Refer to Section 01 78 50, Operating and Maintenance Data, for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
 2. Furnish three complete sets of Operating and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operating and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Start compiling data upon approval of submittals.
 - a. Sets shall incorporate the following:
 - 1) Product Data.
 - 2) Shop Drawings.
 - 3) Record Drawings.
 - 4) Service telephone number, address and contact person for each category of equipment or system.
 - 5) Complete operating instructions for each item of fire sprinkler system.
 - a) Original manual of NFPA-25 for fire sprinkler system.
 - 6) Copies of guarantees/warranties for each item of equipment or systems.
 - 7) Test data as specified.
 - 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
 - 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
 - 10) Check test and start reports for each piece of fire protection equipment provided as part of the Work.
 - 11) Commissioning and Preliminary Operation Tests required as part of the Work.
 - b. Post service telephone numbers and addresses in an appropriate place designated by Architect.
- B. Record Drawings:
1. Refer to Section 01 78 20, Project Record Documents, for requirements governing Work specified herein.
 2. Upon completion of the work, deliver to Architect the following:
 - a. Originals of drawings showing the Work exactly as installed.
 - b. One complete set of reproducible drawings showing the Work exactly as installed.
 - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
 - d. Provide Contractor's signature, verifying accuracy of record drawings.
 - e. Obtain the signature of the Project Inspector for all record drawings.

1.12 SUBSTITUTIONS

- A. Refer to Division 01 Specifications, for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be manufacturers other than those specifically listed in Contract Documents by brand name, model, or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:
 - 1. Reason for substitution request.
 - 2. Complete submittal information as described herein; see "Submittals."
 - 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
 - 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
 - 5. Explanation of impact on connected utilities.
 - 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.
- G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

1.13 QUALITY ASSURANCE

- A. For installing contractor qualifications refer to Section 21 13 13, "Wet-Pipe Sprinkler Systems."

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.15 FIELD CONDITIONS

- A. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by Architect and shall be made without additional cost to Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify Architect if services are found which are not shown on Drawings.

1.16 WARRANTY

- A. Refer to Division 01 Specifications for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.
- B. Repair or replace defective work, material, or part that appears within warranty period, including damage caused by leaks.
- C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

1.17 COORDINATION

- A. General:
 - 1. Coordinate Work in this Section with trades covered in other Specification Sections to provide a complete and operable installation of highest quality workmanship.
- B. Electrical Coordination:
 - 1. Refer to Section 26 05 30, "Conduit and Wire," for service voltage and power feed wiring for equipment specified in this Section. Contractor has full responsibility for the following items of work:
 - a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
 - b. If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of bid.
 - c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.
- C. Mechanical Coordination:
 - 1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
 - 2. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.
 - 3. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum.

2.02 MATERIALS

- A. No material installed as part of this Work shall contain asbestos.
- B. California Green Building Code Compliance:

1. Fire protection equipment shall not contain CFCs.
2. Fire protection equipment shall not contain Halons.

2.03 VALVE BOXES

- A. General:
1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
 2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
 3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
- C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or equal, 8 inches inside diameter by 30 inches long, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
- D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron or steel locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or equal, with extension to suit conditions.

2.04 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to fire protection equipment or devices, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
1. Access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Section 08 31 00, "Access Doors and Panels," except as noted in this Section.
- C. [Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for other areas.
- D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with Architect when access is required in these areas.
- E. Where specific information or details relating to access panels different from the above is shown or given on Drawings or other Divisions of work, that information shall supersede this specification.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
1. Milcor:

- a. Style K (plaster)
- b. Style DW (gypsum board)
- c. Style M (masonry)
- d. Style "Fire Rated" where required

PART 3 - EXECUTION

3.01 FRAMING, CUTTING AND PATCHING

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.
- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.

3.02 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the fire protection Work with the electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for controls. Before permitting operation of equipment which is furnished, installed, or modified under this Section, Contractor shall review associated electrical work, including overload protection devices, and assume complete responsibility for correctness of electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. Equipment and connections exposed to weather shall be installed in NEMA IIIIR enclosures with factory wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with fire protection system are included in this Section. Wiring and conduit shall comply with Division 26.

3.03 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

3.04 INSTALLATION OF PIPING SYSTEMS

- A. At time of final connection, and prior to opening valve to allow pressurization of water piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on fire protection piping is greater than 175 psi, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.
- B. General:
 - 1. Piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
 - 2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.

3. Install piping to permit application of insulation where required and to allow valve servicing.
4. Where piping or conduit is left exposed within a room, the piping or conduit shall be run true to vertical, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from Architect.
6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
8. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
9. Install horizontal valves with valve stem above horizontal.
10. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
11. Verify final equipment locations for roughing-in.
12. Where piping is installed in walls within one inch of face of stud, provide 16 gauge sheet metal shield plate on face of stud. The shield plate shall extend minimum 1-1/2 inches beyond outside diameter of pipe.

3.05 ACCESS DOORS

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of fire protection systems. Access doors shall provide for complete removal and replacement of equipment.

3.06 EXPANSION ANCHORS IN HARDENED CONCRETE:

- A. Refer to Structural Drawings.

3.07 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put fire protection systems into service and check that work required has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of tests.
 1. Refer to Division 21 technical Sections for specific testing requirements.
 2. All equipment has been cleaned, and damaged painted finishes touched up.
 3. Missing or damaged parts have been replaced.
 4. Flushing of piping systems has been completed and water treatment equipment, where specified, is completed.
 5. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
 6. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
 7. Maintenance manuals have been delivered and Owner training has been completed.

B. Review of Contractor's Tests:

1. Tests made by Contractor or manufacturers' representatives are subject to observation and review by Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon completion of tests, provide report to confirm that testing has been successful.

C. Test Logs:

1. Maintain test logs listing the tests on mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of tests.

3.08 COMMISSIONING

- A. This Project will be commissioned by a third-party Commissioning Agent. In addition to the requirements of this Section, comply with the requirements of Section 01 81 00, "Commissioning."

END OF SECTION

SECTION 21 05 17
SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
- B. Related Requirements:
 - 1. Section 078400 " Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.02 SLEEVE-SEAL SYSTEMS

- 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. Metraflex Company (The).
 - 2. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel or Stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

2.03 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.

PART 3 - EXECUTION

3.01 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. 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.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch 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."
- E. 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 00 "Firestopping."

3.02 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.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete and CMU Walls above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.

2. Exterior Concrete and CMU Walls below Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel 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:
 - a. Piping Smaller Than NPS 6: Galvanized-steel 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.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 21 05 18
ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.02 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.02 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass 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: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.02 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 21 05 23
GENERAL-DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Two-piece ball valves with indicators.
 - 2. Bronze butterfly valves with indicators.
 - 3. Iron butterfly valves with indicators.
 - 4. Check valves.
 - 5. Bronze OS&Y gate valves.
 - 6. Iron OS&Y gate valves.
 - 7. NRS gate valves.
 - 8. Trim and drain valves.

1.02 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.04 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 weld ends.
 - 3. Set 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.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Main Level: HAMV - Fire Main Equipment.
 - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
 - b. Level 1: HLOT - Valves.
 - 1) Level 3: HLUG - Ball Valves, System Control.
 - 2) Level 3: HLXS - Butterfly Valves.
 - 3) Level 3: HMER - Check Valves.
 - 4) Level 3: HMRZ - Gate Valves.
 - 2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
 - a. Level 1: VQGU - Valves, Trim and Drain.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
 - 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves.
 - 1) Gate valves.
 - 2) Check valves.
 - a) Single check valves.
 - 3) Miscellaneous valves.
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B1.20.1 for threads for threaded-end valves.
 - 3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- F. NFPA Compliance: Comply with NFPA 24 for valves.
- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.02 TWO-PIECE BALL VALVES WITH INDICATORS

- 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. NIBCO INC.
 - 2. Victaulic Company.
- B. Description:
 - 1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Design: Two piece.
 - 4. Body Material: Forged brass or bronze.
 - 5. Port Size: Full or standard.
 - 6. Seats: PTFE.
 - 7. Stem: Bronze or stainless steel.
 - 8. Ball: Chrome-plated brass.
 - 9. Actuator: Worm gear or traveling nut.
 - 10. Supervisory Switch: Internal or external.
 - 11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
 - 12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

- 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. Globe Fire Sprinkler Corporation.
 - 2. Milwaukee Valve Company.
- B. Description:
 - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
 - 2. Minimum: Pressure rating: 175 psig.
 - 3. Body Material: Bronze.
 - 4. Seat Material: EPDM.
 - 5. Stem Material: Bronze or stainless steel.
 - 6. Disc: Bronze or Stainless steel.
 - 7. Actuator: Worm gear or traveling nut.
 - 8. Supervisory Switch: Internal or external.
 - 9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
 - 10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.04 IRON BUTTERFLY VALVES WITH INDICATORS

- 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. Anvil International; a subsidiary of Mueller Water Products, Inc.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Tyco Fire & Building Products LP.
- B. Description:
 - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Material: Cast or ductile iron.
 - 4. Seat Material: EPDM.
 - 5. Stem: Stainless steel.
 - 6. Disc: Ductile iron, nickel plated.
 - 7. Actuator: Worm gear or traveling nut.
 - 8. Supervisory Switch: Internal or external.
 - 9. Body Design: Lug or wafer, or Grooved-end connections.

2.05 CHECK VALVES

- 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. Anvil International; a subsidiary of Mueller Water Products, Inc.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Tyco Fire & Building Products LP.
 - 4. Viking Corporation.
- B. Description:
 - 1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Type: Single swing check.
 - 4. Body Material: Cast iron, ductile iron, or bronze.
 - 5. Clapper: Bronze, ductile iron, or stainless steel.
 - 6. Clapper Seat: Brass, bronze, or stainless steel.
 - 7. Hinge Shaft: Bronze or stainless steel.
 - 8. Hinge Spring: Stainless steel.
 - 9. End Connections: Flanged, grooved, or threaded.

2.06 BRONZE OS&Y GATE VALVES

- 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. Milwaukee Valve Company.
2. NIBCO INC.
3. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.07 IRON OS&Y GATE VALVES

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. Hammond Valve.
2. Mueller Co.
3. Victaulic Company.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged, Grooved, or Threaded.

2.08 NRS GATE VALVES

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. Mueller Co.
2. Victaulic Company.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged, Grooved, or Threaded.

2.09 TRIM AND DRAIN VALVES

A. Ball Valves:

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. Tyco Fire & Building Products LP.
 - b. Victaulic Company.
2. Description:
 - a. Pressure Rating: 175 psig
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port size: Full or standard.
 - e. Seats: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Handlever.
 - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
 - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

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. Fire Protection Products, Inc.
 - b. NIBCO INC.
 - c. United Brass Works, Inc.
2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Brass or bronze.

- c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
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. NIBCO INC.
 - b. United Brass Works, Inc.
 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.01 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.

3.02 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- B. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

- C. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above the pipe center.
- E. Install valves in position to allow full stem movement.
- F. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- G. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- H. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION

SECTION 21 05 48
VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe-riser resilient supports.
 - 2. Resilient pipe guides.
 - 3. Elastomeric hangers.
 - 4. Snubbers.
 - 5. Restraint channel bracings.
 - 6. Seismic-restraint accessories.
 - 7. Mechanical anchor bolts.
- B. Related Requirements:
 - 1. Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
 - 2. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.02 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any. Refer to Section 21 00 50, "Common Work Results for Fire Suppression Systems," for additional requirements.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.

- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: 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 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the CBC 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 and shall bear anchorage preapproval OPM number from OSHPD, showing maximum seismic-restraint ratings. If preapproved ratings are unavailable, provide calculations (including combining shear and tensile loads) to support seismic-restraint designs signed and sealed by a qualified structural engineer registered in the State of California. For additional requirements, refer to Section 21 00 50, "Common Work Results for Fire Suppression System."

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Refer to structural Drawings.
 - 2. Rated strengths, features, and applications shall be as defined in reports by OSHPD or provide calculations, signed and sealed by a qualified structural engineer registered in the State of California.
 - a. 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 are subjected.

2.02 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.03 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post-and-sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.04 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 - 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. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - 2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.05 RESTRAINT CHANNEL BRACINGS

- 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. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut; an Atkore International company.
- 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 and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.06 SEISMIC-RESTRAINT ACCESSORIES

- 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. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. TOLCO.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections, or Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.
- 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.

2.07 MECHANICAL ANCHOR BOLTS

- 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. 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 E 488.

PART 3 - EXECUTION

3.01 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 of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD or 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 due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. All seismic restraint devices shall be installed in accordance with their listings.
- B. 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 03 30 00 "Cast-in-Place Concrete."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

- D. Equipment Restraints:
 1. Install seismic-restraint devices using methods approved by OSHPD.
- E. Piping Restraints:
 1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
 4. Install seismic-restraint devices using methods approved by OSHPD.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. 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.
- H. 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.
- I. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," and Section 211313 "Wet-Pipe Sprinkler Systems," for piping flexible connections. Comply with requirements in Section 22 05 16, "Expansion Fittings and Loops for Plumbing Piping" for flexible-hose packless expansion joints for use at building seismic joints.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

- C. Tests and Inspections:
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.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 21 05 53
IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 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. Brimar Industries, Inc.
 - b. Marking Services, Inc.
 - c. Seton Identification Products.
 - 2. Material and Thickness: Brass, 0.032 inch, or stainless steel, 0.025 inch thick, with predrilled holes for attachment hardware.
 - 3. Letter Color: Black.
 - 4. Background Color: White.
 - 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 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.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.02 WARNING SIGNS AND LABELS

- 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. Brimar Industries, Inc.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter Color: Red.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

- 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. Brimar Industries, Inc.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to fit circumference of pipe and to attach to pipe without fasteners or adhesive.
- 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: Size letters according to ASME A13.1 for piping.
- E. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- F. Valve Schedules: Valve numbering scheme.

- G. Pipe-Label Colors:
 - 1. Background Color: Safety Red.
 - 2. Letter Color: White.

2.04 VALVE TAGS

- 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. Brimar Industries, Inc.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products.
- B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain.
- 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. Valve-tag schedule shall be included in operation and maintenance data.

2.05 WARNING TAGS

- 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. Brimar Industries, Inc.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products.
- B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety Yellow background with black lettering.

2.06 ACOUSTICAL CEILING LABELS

- A. Provide 1/16 inch thick white nameplate with black letters to identify access to concealed valves or equipment requiring service where located above acoustical ceiling tiles. The nameplate shall be 3/4 inch high by 2-1/2 inches wide. Coordinate the information to be engraved on each plate so that it exactly matches the valve tag or equipment nameplate. The minimum letter height shall be 1/4 inch.

PART 3 - EXECUTION

3.01 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.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. 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. Near each valve and control device.
 - 2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit a view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.05 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 - 1. Valve-Tag Size and Shape:
 - a. Wet-Pipe Sprinkler System: 1-1/2 inches, round.

3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 21 12 00
FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection specialty valves.
 - 3. Hose connections.
 - 4. Alarm devices.
 - 5. Manual control stations.
 - 6. Control panels.
 - 7. Pressure gages.
- B. Related Requirements:
 - 1. Section 210523 "General-Duty Valves for Water-Based Fire-Suppression Piping."
 - 2. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
 - 3. Section 28 46 20, "Fire Alarm." for connections to alarm devices.

1.02 DEFINITIONS

- A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire-suppression standpipes.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. HVAC hydronic piping.
 - 3. Other building services.
 - 4. Refer to Section 21 00 50, "Common Work Results for Fire Suppression Systems," for additional requirements.
- B. Qualification Data: For Installer.

- C. Office of the State Fire Marshall (OSFM) certification cards for automatic fire extinguishing systems sprinkler pipefitters.
- D. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- E. Welding certificates.
- F. Fire-hydrant flow test report.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- H. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Fire Sprinkler Fitter Certification:
 - 1. Automatic fire extinguishing systems sprinkler pipefitters shall be certified by Office of the State Fire Marshall (OSFM).
- C. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- D. 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.
- E. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14.

1.07 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTIONS

- A. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.

2.02 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.
- B. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 - 1. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 2-1/2 Hose Connections: 100 psig.
- C. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13, and ASCE/SEI 7.

2.03 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations, and pipe sizes.

2.04 BLACK STEEL PIPE AND ASSOCIATED FITTINGS

- A. Schedule 40: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.
- B. Schedule 40: ASTM A 795/A 795M, Type E, Grade A; with factory- or field-formed ends to accommodate joining method.
- C. Uncoated, Steel Couplings: ASTM A 865/A 865M, threaded.
- D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Anvil International.
 - b. Shurjoint Piping Products USA Inc.
 - c. Smith-Cooper International.
 - d. Tyco Fire Products LP.
 - e. Victaulic Company.
 - 2. Pressure Rating: 175 psig minimum.

3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.05 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.06 SPECIALTY VALVES

- A. General Requirements:
 1. Standard: UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
 2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 3. Body Material: Cast or ductile iron.
 4. Size: Same as connected piping.
 5. End Connections: Flanged or grooved.
- B. Alarm Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 2. Standard: UL 193.
 3. Design: For horizontal or vertical installation.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
- C. Automatic (Ball Drip) Drain Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kidde Fire Fighting; A UTC Business Unit.

- b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
2. Standard: UL 1726.
 3. Pressure Rating: 175 psig minimum.
 4. Type: Automatic draining, ball check.
 5. Size: NPS 3/4.
 6. End Connections: Threaded.

2.07 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Kidde Fire Fighting; A UTC Business Unit.
 - c. Potter Roemer LLC.
 - d. Tyco Fire Products LP.
 - e. Viking Corporation.
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle or gate.
9. Finish: Rough brass or bronze.

2.08 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Notifier.
 - c. Potter Electric Signal Company, LLC.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.

4. Size: 8-inch minimum diameter.
 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
 - e. Viking Corporation.
 - f. Watts; a Watts Water Technologies company.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig.
 7. Design Installation: Horizontal or vertical.
- D. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Barksdale, Inc.
 - b. Detroit Switch, Inc.
 - c. Kidde Fire Fighting; A UTC Business Unit.
 - d. Potter Electric Signal Company, LLC.
 - e. System Sensor.
 - f. Tyco Fire Products LP.
 - g. United Electric Controls Co.
 - h. Viking Corporation.
 2. Standard: UL 346.
 3. Type: Electrically supervised water-flow switch with retard feature.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design Operation: Rising pressure signals water flow.
- E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.
- F. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.09 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. AMETEK, Inc.
 2. Ashcroft Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: Zero to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.02 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Section 331000 "Site Water Utilities."
- B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.04 WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 211313 "Wet-Pipe Sprinkler Systems."
- B. Install shutoff valve, pressure gage, drain, and other accessories at connection to water-distribution piping. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.05 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install drain valves on standpipes. Extend drain piping to outside of building.
- F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- G. Install alarm devices in piping systems.

- H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- J. Fill wet-type standpipe system piping with water.
- K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.06 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. 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.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.07 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.

3.08 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 2-1/2 hose connections with quick-disconnect

3.09 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260500 "Common Work Results for Electrical."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Start and run air compressors.
 6. Coordinate with fire-alarm tests. Operate as required.
 7. Verify that equipment hose threads are same as local fire-department equipment.

- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 6 and smaller, shall be the following:
 - 1. Schedule 40 black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

END OF SECTION

SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Specialty valves.
 - 3. Sprinklers.
 - 4. Alarm devices.
 - 5. Pressure gages.
- B. Related Requirements:
 - 1. Section 21 05 23 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.02 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.
- C. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 - 1. Refer to Section 21 00 50, "Common Work Results for Fire Suppression Systems," for additional requirements.
 - 2. Provide minimum 1/4 inch equals one foot scaled coordination drawings showing plan and pertinent section or elevation views of fire protection piping, equipment, and accessories. Drawings shall be reproducible and work represented shall be fully coordinated with structure, other disciplines, and with finishes. Drawings shall be presented on a single size sheet. Coordination drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to DSA approved Drawings.

3. Coordination drawings shall depict changes and additions to fire protection system required for coordination with work of other trades. Changes and additions shall be clouded.
 4. Note on coordination drawings piping which will project beyond finished surfaces of normally occupied rooms, exterior of building or other locations which will expose system to view.
 5. Coordination drawings shall be provided with note affirming that the fire sprinkler system shown has been coordinated with the HVAC Contractor for inclusion in Coordinated Layout specified in Section 23 31 13, "Metal Ducts." Provide signature of person responsible for information supplied and date of transmission.
 6. Refer to Section 21 00 50, "Common Work Results for Fire Suppression Systems," for additional requirements.
- B. For proposed changes to supports, anchorage, and seismic restraints shown on DSA approved Contract Drawings, submit details and calculations prepared, sealed, and signed by a California registered structural engineer. Comply with requirements of Section 22 00 50, "Common Work Results for Fire Suppression Systems
 - C. Office of the State Fire Marshall (OSFM) certification cards for automatic fire extinguishing systems sprinkler pipefitters.
 - D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - E. Qualification Data: For qualified Installer and professional engineer.
 - F. Welding certificates.
 - G. Field Test Reports:
 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 2. Fire-hydrant flow test report.
 - H. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.06 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.07 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of fire protection products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer Qualifications:
 - 1. A firm with at least five years of successful installation experience on projects with fire sprinkler piping systems similar to that required for this Project.
 - a. A State of California Fire Protection Contractor's license (C-16) is required.
- C. Fire Sprinkler Fitter Certification:
 - 1. Automatic fire extinguishing systems sprinkler pipefitters shall be certified by Office of the State Fire Marshall (OSFM).
- D. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.08 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13, CBC, and ASCE/SEI 7.

2.02 STEEL PIPE AND FITTINGS

- A. Schedule 40, Black-Steel or Galvanized Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method. Corrosion Resistance Ratio (CRR) Shall be 1.0 or greater.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- C. Malleable- or Ductile-Iron Unions: UL 860.
- D. Cast-Iron Flanges: ASME 16.1, Class 125.
- E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Anvil International.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products USA Inc..
 - e. Smith-Cooper International.
 - f. Tyco Fire Products LP.
 - g. Victaulic Company.
 2. Pressure Rating: 175-psig minimum.
 3. Galvanized Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
 - d. Venus Fire Protection Ltd.
 - e. Victaulic Company.
 - f. Viking Corporation.
 2. Standard: UL 193.
 3. Design: For horizontal or vertical installation.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.

5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
7. 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.

2.04 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Anvil International.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products USA Inc.
 - d. Tyco Fire Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.05 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Globe Fire Sprinkler Corporation.
 2. Tyco Fire Products LP.
 3. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
 1. Nonresidential Applications: UL 199.
 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- E. Sprinkler Finishes: Chrome plated and bronze.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 1. Ceiling Mounting: Steel, white finish, one piece, flat.
 2. Sidewall Mounting: Steel, white finish, one piece, flat.
- G. Sprinkler Guards:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Tyco Fire Products LP.
 - b. Viking Corporation.
 2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.06 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm Bell:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Notifier.
 - c. Potter Electric Signal Company, LLC.
 2. Standard: UL 464.
 3. Type: Vibrating, metal alarm bell.
 4. Size: 8-inch minimum diameter.
 5. Finish: Red-enamel factory finish, suitable for outdoor use.
 6. 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.
- C. Water-Flow Indicators:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
 - e. Viking Corporation.
 - f. Watts; a Watts Water Technologies company.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig.
 7. Design Installation: Horizontal or vertical.
- D. Pressure Switches:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Tyco Fire Products LP.
 - b. Viking Corporation.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised water-flow switch with retard feature.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design Operation: Rising pressure signals water flow.
- E. Valve Supervisory Switches:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. Potter Electric Signal Company, LLC.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.
 - 6. 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.

2.07 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. AMETEK, Inc.
 - 2. Ashcroft Inc.
 - 3. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0- to 250-psig minimum.
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.02 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- M. Fill sprinkler system piping with water.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

3.03 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.04 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.05 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Provide return bend as illustrated in NFPA 13 (NFPA exceptions do not apply) for each sprinkler head installed in finished ceiling.

3.06 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 00 "Common Work Results for Electrical."

3.07 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.08 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.09 DEMONSTRATION AND TRAINING

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Provide minimum one hour of training.

3.10 PIPING SCHEDULE

- A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
 - 1. Schedule 40, black-steel or galvanized pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be the following:
 - 1. Schedule 10, black-steel pipe with grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
 - a. Ceilings at 9 feet 0 inches or lower: Recessed or concealed.
 - b. Ceiling at 8 feet 0 inches or lower: Concealed.
 - c. Ceilings in unsupervised areas such as corridors, arcades, and restrooms with a ceiling height of 9 feet 0 inches or lower: Concealed.
 - 3. Wall Mounting: Sidewall sprinklers.

- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Residential Sprinklers: Dull chrome.
 5. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
- C. Provide sprinkler guards on sprinkler heads installed at 7 feet 6 inches above finished floor or lower in exposed locations or those that are deemed subject to damage. Sprinkler guard shall be securely fastened with a bolt-on feature to the base of the sprinkler or be a factory-installed guard. Guards shall also be provided on upright and sidewall heads where sprinklers are installed at 7 feet 6 inches above finished floor or lower.
- D. Sprinkler heads installed in suspended ceiling shall comply with DSA IR 25 2.13 and 3.13.

END OF SECTION

SECTION 22 00 50
COMMON WORK RESULTS FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all Division 22 Sections.

1.02 RELATED REQUIREMENTS

- A. This Section is a part of each Division 22 Section.
- B. Section 23 11 23, Facility Natural Gas Piping: Requirements for natural gas piping system.

1.03 ADDITIONAL REQUIREMENTS

- A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
- B. Make all temporary connections required to maintain services during the course of this Contract without additional cost to the Owner. Notify the Owner seven days in advance before disturbing services.
- C. All plumbing work required by Contract Documents shall be performed in strict accordance with all codes and regulations. Plumbing work done under this Contract shall not adversely affect the operation of the existing plumbing systems.

1.04 REFERENCES AND STANDARDS

- A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.
 - 1. CSA – Canadian Standards Association International.
 - 2. ANSI - American National Standards Institute.
 - 3. ASTM - American Society for Testing and Materials.
 - 4. CCR - California Code of Regulations.
 - a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36.
 - 5. NCPWB - National Certified Pipe Welding Bureau.
 - 6. CEC - California Electrical Code.
 - 7. NEMA - National Electrical Manufacturers' Association.
 - 8. NFPA - National Fire Protection Association.
 - 9. OSHA - Occupational Safety and Health Act.
 - 10. UL - Underwriters' Laboratories, Inc.
- B. Requirements of Regulatory Agencies:
 - 1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.

2. Code editions shall be as noted on Drawings, as adopted by the California Division of the State Architect (DSA).
 - a. California Building Code.
 - b. California Electrical Code.
 - c. California Energy Code.
 - d. California Fire Code.
 - e. California Green Building Standards Code.
 - f. California Mechanical Code
 - g. California Plumbing Code
 - h. California Code of Regulations, Title 24.
 - i. California Health and Safety Code.
 - j. CAL-OSHA.
 - k. California State Fire Marshal, Title 19 CCR.
 - l. National Fire Protection Association.
 - m. Occupational Safety and Health Administration.
 - n. Other applicable state laws.
3. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

1.05 DRAWINGS

- A. Examine Contract Documents prior to bidding of work and report discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The Plumbing Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
 1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over Plumbing Drawings.
 2. Because of the small scale of Plumbing Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.
 3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contactors' expense upon Architects' direction.
 4. Minor changes in locations of equipment, piping, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such

change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.

- C. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.06 FEES AND PERMITS

- A. Obtain and pay for all permits and service required in installation of this work; arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
 - 1. Contractor shall bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.

1.07 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Submittals shall be submitted in accordance with the requirements of Section 01 33 00, Submittal Procedures.
 - 2. Closeout Submittals shall be submitted in accordance with the requirements of Section 01 77 00, Closeout Procedures.
- B. Coordination:
 - 1. General:
 - a. Coordinate plumbing Work with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.
 - 2. Electrical Coordination:
 - a. Refer to Section 26 05 30, "Conduit and Wire," for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
 - 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
 - 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.
 - 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.
 - 3. Mechanical Coordination:

- a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
- b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.
- c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces.
- d. Coordinate with other trades equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to other trades as required for a completely coordinated project.

1.08 SUBMITTALS - GENERAL

- A. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.
- B. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used. Refer to Division 01 for complete instructions.
 - 1. Partial or incomplete submittals will not be considered.
 - 2. Quantities are Contractor's responsibility and will not be reviewed.
 - 3. Provide materials of the same brand or manufacturer for each class of equipment or material.
 - 4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
 - 5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
 - 6. Organize submittals in same sequence as in Specification Sections.
 - 7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
 - a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
 - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
 - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.

- d. Catalog cuts and published material may be included with supplemental scaled drawings.
- C. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.
- D. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect Shop Drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.
 - 1. Shop Drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.
- E. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

1.09 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing systems materials and products.
- B. Shop Drawings.
- C. Provide product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. Sustainable Design Submittals:
 - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.
- E. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.10 INFORMATIONAL SUBMITTALS

- A. Provide layouts for plumbing systems, for inclusion in coordinated layout specified in Section 23 31 13, "Metal Ducts." Comply with requirements for layouts specified in Section 23 31 13.
- B. Equipment training session agenda.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

1. Refer to Section 01 78 50, Operating and Maintenance Data, for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
 2. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Begin compiling data upon approval of submittals.
 - a. Sets shall incorporate the following:
 - 1) Product Data.
 - 2) Shop Drawings.
 - 3) Record Drawings.
 - 4) Service telephone number, address and contact person for each category of equipment or system.
 - 5) Complete operating and maintenance instructions for each item of plumbing equipment and systems.
 - 6) Copies of guarantees/warranties for each item of equipment and systems.
 - 7) Test data and system balancing reports.
 - 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
 - 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
 - 10) Control diagrams and literature.
 - 11) Check test and start reports for each piece of plumbing equipment provided as part of the Work.
 - 12) Commissioning and Preliminary Operation Tests required as part of the Work.
 - b. Post service telephone numbers and/or addresses in an appropriate place as designated by the Architect.
- B. Record Drawings:
1. Refer to Section 01 78 20, Project Record Documents, for requirements governing Work specified herein.
 2. Upon completion of the work, deliver to Architect the following:
 - a. Originals of drawings showing the Work exactly as installed.
 - b. One complete set of reproducible drawings showing the Work exactly as installed.
 - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
 - d. Provide Contractor's signature, verifying accuracy of record drawings.
 3. Obtain the signature of the Project Inspector of Record for record drawings.

1.12 SUBSTITUTIONS

- A. Refer to Division 01 Specifications for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be all manufacturers other than those specifically listed in the Contract Documents by brand name, model or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:
 - 1. Reason for substitution request.
 - 2. Complete submittal information as described herein; see "Submittals."
 - 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
 - 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
 - 5. Explanation of impact on connected utilities.
 - 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is the Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of reviewed substituted equipment or material must be made by the Contractor without additional cost to the Owner. Review by the Architect of the substituted equipment or material, including dimensioned Drawings will not waive these requirements.
- G. Contractor may be required to compensate the Architect for costs related to substituted equipment or material.

1.13 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with plumbing systems work similar to that required for this Project.
- C. Comply with applicable portions of California Plumbing Code pertaining to selection and installation of plumbing materials and products.
- D. All materials and products shall be new and shall match existing.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and piping delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.15 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.
- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

1.16 WARRANTY

- A. Refer to Division 01 Specifications for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.
- B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.
- C. On failure to comply with the above warranty within a reasonable length of time after notification is given, the Architect/Owner shall have the repairs made at the Contractor's expense.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.
- C. Refer to Division 22 technical Sections for specific system piping materials.

2.02 MATERIALS

- A. No material installed as part of this Work shall contain asbestos.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.03 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Provide magnetic motor starters for equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.
 - 1. All starters shall have the following:

- a. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
 - b. Ambient compensated thermal overload.
 - c. Fused control transformer (for 120 or 24 volt service).
 - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIIR enclosures.
2. Where three phase motors are provided for two-speed operation, provide two speed motor starters.
 3. Starters for single-phase motors shall have thermal overloads. NEMA I enclosure for starters located indoors, NEMA IIIIR enclosure for starters located outdoors.
 4. Provide OSHA label indicating the device starts automatically.

2.04 VALVE BOXES

A. General:

1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.

B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.

C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or equal, 8 inches inside diameter by 30 inches long, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.

D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron or steel locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or equal, with extension to suit conditions.

2.05 ACCESS DOORS

A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.

1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.

B. Access doors shall match those supplied in Section 08 31 00, "Access Doors and Panels," except as noted in this Section.

C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.

- D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.
- E. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
 - 1. Milcor
 - a. Style K (plaster).
 - b. Style DW (gypsum board).
 - c. Style M (Masonry).
 - d. Style "Fire Rated" where required.

PART 3 - EXECUTION

3.01 FRAMING, CUTTING AND PATCHING

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.
- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.

3.02 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIIIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

3.03 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic 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 coordination drawings.

3.04 INSTALLATION OF PIPING SYSTEMS

- A. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.
- B. General:
1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
 2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
 3. Install piping to permit application of insulation and to allow valve servicing.
 4. Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
 5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
 6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
 7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
 8. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.
 9. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
 10. Install horizontal valves with valve stem above horizontal.
 11. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
 12. Verify final equipment locations for roughing-in.
 13. Sanitary Sewer and Storm Drain: Grade piping inside building uniformly 1/4 inch per foot if possible but not less than 1/8 inch per foot. Run piping as straight as possible. Make piping connections between building piping and outside service pipe with cast iron reducers or increasers. Slope sewers uniformly between given elevations where invert elevations are shown.
 14. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

3.05 ACCESS DOORS

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps,

cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.06 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Refer to Structural Drawings.

3.07 OPERATION OF SYSTEMS

- A. Do not operate any plumbing equipment for any purpose, temporary or permanent, until all of the following has been completed:
 - 1. Complete all requirements listed under "Check, Test and Start Requirements."
 - 2. Piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
 - 3. Filters, strainers etc. are in place.
 - 4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
 - 5. Equipment has been run under observation, and is operating in a satisfactory manner.
- B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.

3.08 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of plumbing equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
 - 1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
 - 2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
 - 3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
 - 4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each operating and maintenance manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

3.09 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put all mechanical systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.
 - 1. Refer to Division 22 technical Sections for specific testing requirements.
 - 2. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations.
 - 3. Correct rotation of motors and ratings of overload heaters are verified.
 - 4. Specified filters are installed and spare filters have been turned over to Owner.
 - 5. All manufacturers' certificates of start-up specified have been delivered to the Owner.
 - 6. All equipment has been cleaned, and damaged painted finishes touched up.
 - 7. Missing or damaged parts have been replaced.
 - 8. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.
 - 9. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
 - 10. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
 - 11. Preliminary test and balance work is complete, and reports have been forwarded for review.
 - 12. Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.
 - 13. Operation and Maintenance Manuals have been delivered and instructions to the operating personnel have been made.
- B. Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.
 - 1. Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.
 - 2. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.
 - 3. During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.
- C. Review of Contractor's Tests:
 - 1. All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide report to confirm that all testing has been successful.
- D. Test Logs:

1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.
- E. Preliminary Operation:
1. The Owner reserves the right to operate portions of the plumbing system on a preliminary basis without voiding the guarantee.

3.10 CERTIFICATES OF INSTALLATION

- A. Contractor shall complete applicable "Certificates of Installation" forms contained in the California Building Energy Efficiency Standards and submit to the authorities having jurisdiction for approval and issuance of final occupancy permit, as described in the California Energy Code.

3.11 DEMONSTRATION AND TRAINING

- A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
 2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
 3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
 - a. Listing of Owner-designated personnel completing training, by name and title.
 - b. Name and title of training instructor.
 - c. Date(s) of training.
 - d. List of topics covered in training sessions.
 4. Refer to specific equipment Sections for minimum training period duration for each piece of equipment.

3.12 COMMISSIONING

- A. This Project will be commissioned by a third-party Commissioning Agent. In addition to the requirements of this Section, comply with the requirements of Section 01 81 00, "Commissioning."

END OF SECTION

SECTION 22 05 13
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 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.

1.02 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.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.02 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.

2.03 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 and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 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. Energy and Premium-Efficient Motors – Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Each motor shall be provided with a shaft grounding device for stray current protection.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 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

SECTION 220516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flexible-hose packless expansion joints.
 - 2. Alignment guides and anchors.
 - 3. Pipe loops and swing connections.

1.02 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.

1.03 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 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.

2.02 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Metraflex Company (The), Metraflex Inc., Fireloop series.
 - b. 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. Provide UL listed assembly selected for 4 inches of movement.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

2.03 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Mason Industries, Inc.
 - b. Metraflex Company (The).
 - c. Unisource Manufacturing, 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 A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, 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.

PART 3 - EXECUTION

3.01 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

- B. Install rubber packless expansion joints according to FSA-PSJ-703.

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

- 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.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- 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

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
 - 4. Silicone sealants.
- B. Related Requirements:
 - 1. Section 078400 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized zinc coated, with plain ends.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.

3. GPT; an EnPro Industries company.
 4. Metraflex Company (The).
 5. Proco Products, Inc.
- B. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 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.
 3. Pressure Plates: Carbon steel.
 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.03 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, 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.

PART 3 - EXECUTION

3.01 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, 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. Comply with requirements for sealants specified in Section 079200, "Joint Sealants."
- 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 078400 "Firestopping"

3.02 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.

3.03 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: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves.
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Steel 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: Steel 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: Steel 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: Steel 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. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 22 05 18
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.02 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.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.

2.02 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 polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

2.03 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 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 New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Insulated Piping: One-piece stamped steel with polished, chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece stamped steel with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece stamped steel 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: One-piece, floor plate. Cast-iron flange with holes for fasteners.

3.02 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
 - 7. Sight flow indicators.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Ashcroft Inc.
 - 2. Marsh Bellofram.
 - 3. Miljoco Corporation.
 - 4. Palmer Wahl Instrumentation Group.
 - 5. REOTEMP Instrument Corporation.
 - 6. Trerice, H. O. Co.
 - 7. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: 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.

2.02 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. Type: Stepped shank unless straight or tapered shank is indicated.
 5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 7. Bore: Diameter required to match thermometer bulb or stem.
 8. Insertion Length: Length required to match thermometer bulb or stem.
 9. Lagging Extension: Include on thermowells for insulated piping and tubing.
 10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.03 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. REOTEMP Instrument Corporation.
 - d. Weiss Instruments, Inc.
 - e. Weksler Glass Thermometer Corp.
 2. Standard: ASME B40.100.
 3. Case: Liquid-filled 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 1/4, 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.

2.04 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, 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 1/4, ASME B1.20.1 pipe threads.

2.05 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. WATTS.
 4. Weiss Instruments, Inc.
 5. Weksler Glass Thermometer Corp.
- 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, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: EPDM self-sealing rubber.

2.06 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. WATTS.
 4. Weiss Instruments, Inc.

- B. Furnish one test-plug kit(s) containing one thermometer(s), 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.

2.07 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. ARCHON Industries, Inc.
 - 2. Dwyer Instruments, Inc.
 - 3. Emerson Process Management; Rosemount Division.
 - 4. Ernst Flow Industries.
 - 5. John C. Ernst Co., Inc.
 - 6. Pentair Valves & Controls; Penberthy Brand.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 125 psig.
- E. Minimum Temperature Rating: 200 deg F.
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter 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.
- 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.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.06 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
 - 1. Sealed, direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Sealed, direct-mounted, metal case.
 - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Steel ball valves.
 - 4. Iron ball valves.
 - 5. Bronze swing check valves.
 - 6. Bronze gate valves.

1.02 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
- B. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.
 - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set gate valves closed to prevent rattling.
 - 4. Set ball valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- 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 handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.9 for building services piping valves.
- C. California Health and Safety Code Compliance: HSC 116875 for valves for potable water service. Valves for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.
 - 1. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
 - 2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handles of nonthermal-conductive 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.

2.02 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. American Valve, Inc.
 - b. Crane; Crane Energy Flow Solutions.

- c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered. See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.
- B. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- a. Apollo Valves; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Jomar Valve.
 - d. KITZ Corporation.
 - e. Marwin Valve; Richards Industries.
 - f. Milwaukee Valve Company.
2. Description:
- a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered. See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.
- C. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- a. Jomar Valve.

- b. KITZ Corporation.
 - c. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered. See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.03 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded and soldered. See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

B. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Milwaukee Valve Company.

- b. NIBCO INC.
 - c. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded and soldered. See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.04 STEEL BALL VALVES

A. Steel Ball Valves with Full Port, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Jamesbury; Metso.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 285 psig.
 - c. Body Design: Split body.
 - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
 - e. Ends: Flanged or threaded. See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

2.05 IRON BALL VALVES

A. Iron Ball Valves, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Conbraco Industries, Inc.

- c. KITZ Corporation.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
2. Description:
- a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged or threaded . See valve schedule articles.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.06 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. American Valve, Inc.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Jenkins Valves; Crane Energy Flow Solutions.
 - d. KITZ Corporation.
 - e. NIBCO INC.
 - f. Watts; a Watts Water Technologies company.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. KITZ Corporation.
 - b. Milwaukee Valve Company.

- c. NIBCO INC.
 - d. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: PTFE.

2.07 BRONZE GATE VALVES

A. Bronze Gate Valves, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- a. Apollo Valves; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.01 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.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
- F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. Use gate valves only where shown on Drawings. Include hose-end connection if applicable for drain service.
- B. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- C. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- D. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two and three piece, full port, brass or bronze with brass or bronze trim.
 - 3. Bronze Swing Check Valves: Class 125, bronze disc.
- 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. Class 150, steel ball valves with full port.
3. Iron Ball Valves: Class 125.

END OF SECTION

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

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Pipe-positioning systems.
 - 7. 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 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Environmental Product Declaration: For each product.
 - 3. Health Product Declaration: For each product.
 - 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- 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. Pipe stands.
 - 4. 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.

1.03 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.04 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. 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 CBC and ASCE/SEI 7 as referenced by the CBC.
 - 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.

2.02 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 carbon steel.
- B. 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.

2.03 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.

2.04 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. B-line, an Eaton business.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Unistrut; Part of Atkore International.
 - e. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 5. Channel Width: Selected for applicable load criteria.
 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 8. Metallic Coating: Electroplated zinc.

2.05 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. Pipe Shields Inc.
 6. Piping Technology & Products, Inc.
 7. Rilco Manufacturing Co., Inc.
 8. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier. .
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-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.

2.06 FASTENER SYSTEMS

- A. 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. Refer to structural Drawings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. B-line, an Eaton business.
 - b. Empire Tool and Manufacturing Co., Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC.
2. Indoor Applications: Zinc-coated steel.
3. Outdoor Applications: Stainless steel.

2.07 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. 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: Galvanized steel clevis hanger.
 6. Hardware: Stainless steel.
- C. 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 or molded polypropylene.
 3. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
 4. Pipe Supports: Galvanized steel clevis hanger.
 5. Hardware: Stainless steel.
- D. 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.

2.08 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.

2.09 EQUIPMENT SUPPORTS

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

2.10 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

3.01 APPLICATION

- A. Comply with requirements in Section 078400 "Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

3.02 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. 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.
- G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments 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.
- M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. 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.
 - 5. Pipes NPS 8 and Larger: Include 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.

3.03 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.

3.04 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.

3.05 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.

3.06 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 099123 "Interior Painting." And 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.

3.07 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 copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of 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 Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. 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.

16. 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.
 17. 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.
 18. 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.
 19. 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.
 20. 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.
 21. 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.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 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.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment 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.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint 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.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. 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.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.02 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD.

- b. Annotate to indicate application of each product submitted and compliance with requirements.
- 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
 - 1. Calculations performed for use in selection of seismic supports, anchorages, and restraints shall utilize criteria indicated in Structural Contract Documents.
 - 2. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an OSHPD pre-approved system such as Tolco, ISAT, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
 - a. Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation. Gas pipe bracing shall be designed in accordance with California Building Code Section 1615A.1.22 and ASCE 7-10 Section 13.6. Coefficient $I_p = 1.5$ shall be used for gas piping bracing calculations.
 - 3. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2016 California Building Code
 - 4. Additional Requirements: In addition to the above, conform to all state and local requirements.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any. Refer to Section 22 00 50, "Common Work Results for Plumbing Systems for additional requirements.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: 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 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the CBC 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 and shall bear anchorage preapproval OPM number from OSHPD, showing maximum seismic-restraint ratings. For additional requirements, refer to article, Action Submittals.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. See structural documents for wind and seismic restraint loads.
- B. Rated strengths, features, and applications shall be as defined in reports by OSHPD or provide calculations, signed and sealed by a qualified structural engineer registered in the State of California.

2.02 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Smooth pattern.
 - 6. Infused nonwoven cotton or synthetic fibers.
 - 7. Load-bearing metal plates adhered to pads.
 - 8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.03 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.04 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.05 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.

- d. Vibration Mountings & Controls, Inc.
- 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
- 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.06 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.07 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.

- d. Vibration Mountings & Controls, Inc.
- 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
- 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
- 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.08 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.09 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.

- d. Vibration Mountings & Controls, Inc.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Kinetics Noise Control, Inc.
 2. Mason Industries, Inc.
 3. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 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 and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 603 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.

2.16 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. B-line, an Eaton business.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. TOLCO.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or 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.

2.17 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 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 E 488.

PART 3 - EXECUTION

3.01 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 of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD.
- 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 due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND 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. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by OSHPD that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by OSHPD that provides required submittals for component.

- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. 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.
- J. 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.
- K. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 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.

6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
 - E. Prepare test and inspection reports.

3.06 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.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Brimar Industries, Inc.
 - b. Craftmark Pipe Markers.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.
 - 2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 3. Letter Color: White.
 - 4. Background Color: Black.
 - 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 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-quarters the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Brimar Industries, Inc.
 - b. Craftmark Pipe Markers.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 7. 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-quarters the size of principal lettering.
 8. Fasteners: Stainless-steel rivets or self-tapping screws.
 9. 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.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Services Inc.
 4. National Marker Company.

- 5. Seton Identification Products.
- 6. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Red.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Brimar Industries, Inc.
 - 2. Craftmark Pipe Markers.
 - 3. Marking Services Inc.
 - 4. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to 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 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. At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.04 STENCILS

- A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Brimar Industries, Inc.
 - b. Carlton Industries, LP.
 - c. Champion America.
 - d. Craftmark Pipe Markers.
 - e. Kolbi Pipe Marker Co.
 - f. Marking Services Inc.
2. Lettering Size: Size letters according to ASME A13.1 for piping.
3. Stencil Material: Aluminum.
4. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.05 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Services Inc.
 4. Seton Identification Products.
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link chain.
- 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. Valve-tag schedule shall be included in operation and maintenance data.

2.06 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Services Inc.
 4. Seton Identification Products.

- B. Description: 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 minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.01 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 encapsulants.

3.02 GENERAL INSTALLATION 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.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. 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. Near each valve and control device.
 - 2. Near each branch connection, 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. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
1. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety black.
 - b. Letter Color: White.

3.05 VALVE-TAG INSTALLATION

- 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.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Gas: 1-1/2 inches, round.
 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 3. Letter Colors:
 - a. Cold Water: White.
 - b. Hot Water: White.

3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping outside building thermal envelope.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Roof drains and rainwater leaders.
 - 5. Supplies and drains for handicap-accessible lavatories and sinks.

1.02 ACTION 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).
- 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 insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.
- C. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.
- D. Product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.

1.03 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.

1.04 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.05 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.

1.06 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.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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.

PART 2 - PRODUCTS

2.01 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 shall be applied.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Pittsburgh Corning Corporation.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.

2.03 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. 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.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
 2. Adhesive: As recommended by flexible elastomeric manufacturer and with a VOC content of 80 g/L or less.
 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- E. ASJ Adhesive Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 2. Adhesives shall have a VOC content of 80 g/L or less.
 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Dow Corning Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. P.I.C. Plastics, Inc.
 - d. Speedline Corporation.
 2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Knauf Insulation.
 - c. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Knauf Insulation.
 - e. Mon-Eco Industries, Inc.
 - f. Vimasco Corporation.
 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.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. 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).
 - 2. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
 - 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 5. Service Temperature Range: 0 to plus 180 deg F.
 - 6. Color: White.

2.06 SEALANTS

- A. Joint Sealants for Cellular-Glass Products:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - e. Pittsburgh Corning Corporation.
 - 2. Sealant shall have a VOC content of 420 g/L or less.
 - 3. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- B. Metal Jacket Flashing Sealants:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- C. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2.07 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.09 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Alpha Associates, Inc.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - d. Speedline Corporation.
 - 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.
- C. Metal Jacket:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - c. RPR Products, Inc.
 - 2. Aluminum Jacket: Comply with ASTM B 209, 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: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 2.5-mil-thick polysurlyn.

- e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-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.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 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. 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, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Compac Corporation.
 - b. Ideal Tape Co., Inc.; an American Biltrite company.
 - c. Venture Tape.
 - 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.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 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.

2.12 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 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 the following, or equal:
 - a. C & F Wire.

2.13 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.
 - c. McGuire Manufacturing.
 - d. Plumberex Specialty Products, Inc.

- e. Truebro.
 - f. Zurn Industries, LLC.
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.

PART 3 - EXECUTION

3.01 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.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 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 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, 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. 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 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to 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 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. 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.

3.04 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: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078400 "Firestopping" for firestopping and fire-resistive joint sealers.
- E. 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 078400 " Firestopping."

3.05 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.
- B. 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. 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 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 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.
- 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 shall conform 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 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 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.

3.06 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 factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied 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 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 cut sections of cellular-glass block insulation of same thickness as pipe 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 preformed sections of same material as 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 sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed 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.

3.07 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 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 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 preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed 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.

3.08 INSTALLATION OF MINERAL-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 o.c.
 4. For insulation with factory-applied 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 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 mineral-fiber 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 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.

3.09 FIELD-APPLIED JACKET INSTALLATION

- A. 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.
- B. 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.

3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting, and Section 099600, "High Performance Coatings"
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 jackets.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. 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 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.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 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.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water and Industrial Cold Water Outside Building Thermal Envelope:
 - 1. All Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 3/4 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1 and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: 3 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Stormwater and Overflow: (Insulate rainwater leader piping and overflow drain piping from drain to first horizontal offset, and first 5 feet of horizontal piping)
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be the following:
- F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

- G. Hot Service Drains:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
- H. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.15 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.
- D. Piping, Exposed:
 - 1. PVC: 30 mils thick.

3.16 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, Exposed:
 - 1. Painted Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 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 311116 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.02 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.
 - 1. Certification that products comply with NSF 61 Annex G and NSF 372.
- C. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.

1.03 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.05 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 Owner and Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's and Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. 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.
- B. Potable-water piping and components shall comply with NSF 61 Annex G.
- C. Comply with NSF Standard 372 for low lead.

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 1. MSS SP-123.
 2. Cast-copper-alloy, hexagonal-stock body.
 3. Ball-and-socket, metal-to-metal seating surfaces.
 4. Solder-joint or threaded ends.

2.03 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 B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.05 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.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser, Inc.
 - c. Ford Meter Box Company, Inc. (The).
 - d. Jay R. Smith Mfg. Co.
 - e. JCM Industries, Inc.
 - f. Romac Industries, Inc.
 - g. Smith-Blair, Inc.
 - h. Viking Johnson.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - d. Uponor.
 - 2. 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 - 2. 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.

2.06 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. HART Industrial Unions, LLC.
 - e. Jomar Valve.
 - f. Matco-Norca.
 - g. Watts; a Watts Water Technologies company.
 - h. Wilkins.
 - i. Zurn Industries, LLC.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a Watts Water Technologies company.
 - e. Wilkins.
 - f. Zurn Industries, LLC.
 - 2. Standard: ASSE 1079.
 - 3. Factory-fabricated, bolted, companion-flange assembly.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Nonconducting materials for field assembly of companion flanges.
 3. Pressure Rating: 150 psig.
 4. Gasket: Neoprene or phenolic.
 5. Bolt Sleeves: Phenolic or polyethylene.
 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 - e. Victaulic Company.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

3.02 PIPING INSTALLATION

- 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 underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level and plumb.
- G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. 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.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- R. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- S. 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."
- T. 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."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 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. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- F. 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.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION

- 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.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.05 DIELECTRIC FITTING INSTALLATION

- 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.
- 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.

3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. 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.
- 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.07 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. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. 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.

3.08 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.09 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. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. 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.

3.10 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. 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 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.

3.12 PIPING SCHEDULE

- 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. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- D. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 1-1/4 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 1-1/2 and larger shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Temperature-actuated, water mixing valves.
 - 5. Strainers.
 - 6. Hose bibbs.
 - 7. Drain valves.
 - 8. Water-hammer arresters.
 - 9. Trap-seal primer valves.
 - 10. Flexible connectors.
- B. Related Requirements:
 - 1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers and pressure gages in domestic water piping.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.
 - 1. Certification that products comply with NSF 61 Annex G and NSF 372.
- C. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.
- D. Sustainable Design Submittals:
 - 1. Product Data: For water consumption.

1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party

certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G, and NSF 372.

2.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
 - 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: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Arrowhead Brass Products.
 - c. Cash Acme.
 - d. Legend Valve & Fitting, Inc.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts; a Watts Water Technologies company.

- h. Woodford Manufacturing Company.
- i. Zurn Industries, LLC.
- 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: Chrome or nickel plated.

2.04 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ames Co.
 - b. Ames Fire & Waterworks.
 - c. FEBCO.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.
- 4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved [stainless steel] for NPS 2-1/2 and larger.
- 5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 6. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.05 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ITT Corporation.
 - b. NIBCO INC.
 - c. Watts; a Watts Water Technologies company.
- 2. Type: Ball valve with two readout ports and memory-setting indicator.
- 3. Body: 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. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.06 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Leonard Valve Company.
 - b. Powers.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 120 deg. F.
9. Valve Finish: Chrome plated.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Leonard Valve Company.
 - b. Powers.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110 deg. F.

2.07 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
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.062 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.08 HOSE BIBBS

A. Hose Bibbs:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Woodford Manufacturing 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.

2.09 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. 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 B 62 bronze.
 5. Drain: NPS 1/8 side outlet with cap.

2.10 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 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.

2.11 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products.
 - c. Sioux Chief Manufacturing Company, Inc.
 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.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Hyspan Precision Products, Inc.
 4. Metraflex Company (The).
- B. 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.
- C. 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

3.01 INSTALLATION

- A. Install backflow preventers 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. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated, water mixing valves 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.
- D. Install Y-pattern strainers for water on supply side of each control valve and pump.

- E. Install water-hammer arresters in water piping according to PDI-WH 201.
- F. Install supply-type, trap-seal primer valves 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.

3.02 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260501 "Basic Electrical Materials and Methods."
- B. Fire-retardant-treated-wood blocking is specified in Section 260530 "Conduit and Wire" for electrical connections.

3.03 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Calibrated balancing valves.
 - 3. Supply-type, trap-seal primer valves.
- 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."

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.05 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.

1.02 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 11 68 75. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.05 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- C. California Health and Safety Code Compliance: HSC 116875 for pumps for potable water service. Pumps for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.07 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.01 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - 1. TACO Comfort Solutions, Inc.
 - 2. WILO USA LLC - WILO Canada Inc.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. 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. Casing: Bronze, with threaded or companion-flange connections.
 - 3. Shaft and bearing rings: Ceramic.
 - 4. Impeller: Plastic.
 - 5. Motor: Single speed, unless otherwise indicated.
- D. Controls:
 - 1. Illuminated display showing energy consumption, flow, and operating mode.
 - 2. Minimum 3 constant pressure control modes of operation.
- E. Capacities and Characteristics:
 - 1. Capacity: Refer to schedules.
 - 2. Total Dynamic Head: Refer to schedules.
 - 3. Minimum Working Pressure: 125 psig.
 - 4. Maximum Continuous Operating Temperature: 220 deg F.
 - 5. Inlet and Outlet Size: Refer to schedules.
 - 6. Pump Speed: Refer to schedules.
 - 7. Pump Control: Aquastat.
 - 8. Motor Horsepower: Refer to schedules.
 - 9. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phases: Single.
 - c. Hertz: 60.

2.02 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."
 - 1. Electrically commutated motor.

2. 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.

2.03 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, ac.
- 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 ac.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install aquastat in hot-water return piping.

3.03 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in 220523 General-Duty Valves for Plumbing

Piping," and comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties."

- E. Connect aquastats to pumps that they control.

3.04 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 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.
 2. Check piping connections for tightness.
 3. Clean strainers on suction piping.
 4. Set aquastats for automatic starting and stopping operation of pumps.
 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 7. Start motor.
 8. Open discharge valve slowly.
 9. Adjust temperature settings on thermostats.
 10. Adjust timer settings.

3.06 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Requirements:

1. Section 333000 " Sanitary Utilities" for sanitary sewerage piping and structures outside the building.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.04 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 according to requirements indicated:
1. Notify Owner and Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
 2. Do not proceed with interruption of sanitary waste service without Owner's and Construction Manager 's written permission.

PART 2 - PRODUCTS

2.01 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.

2.02 PIPING MATERIALS

- A. Piping materials shall 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.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ANACO-Husky.
 - b. MIFAB, Inc.
 - c. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ANACO-Husky.
 - b. MIFAB, Inc.
 - c. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.05 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.

3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.06 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.07 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. General Requirements: Fitting or device for joining piping with small differences in OD's 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Froet Industries LLC.
 - 4) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring 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.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.

- 2) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - 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.
- B. Dielectric Fittings:
1. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) Capitol Manufacturing Company.
 - 3) Central Plastics Company.
 - 4) HART Industrial Unions, LLC.
 - 5) Jomar Valve.
 - 6) Matco-Norca.
 - 7) Watts; a Watts Water Technologies company.
 - 8) Wilkins.
 - 9) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 2. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca.
 - 4) Watts; a Watts Water Technologies company.

- 5) Wilkins.
- 6) Zurn Industries, LLC.
- b. Description:
 - 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.
- 3. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. 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.
- 4. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Elster Perfection Corporation.
 - 2) Matco-Norca.
 - 3) Precision Plumbing Products.
 - b. 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.

2.08 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.

- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

3.02 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 drain pipe.
 - 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: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- 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 aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Plumbing Specialties:
 - 1. 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."
 - 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. 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."
- S. 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."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to 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.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- E. 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.

3.04 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, nonpressure 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 unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
 - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.05 HANGER AND SUPPORT INSTALLATION

- 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 carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. 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.
- 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 - NPS 5: 10 feet with 1/2-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.06 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. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 6. 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. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- 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.

3.07 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."

3.08 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 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 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-foot head of water. Maintain pressure for four hours.
 - 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.
7. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
8. Prepare reports for tests and required corrective action.

3.09 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.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints shall be installed where piping will be located over critical areas including food preparation, food storage, food serving, dining areas, , nurseries, and other sensitive areas.
 4. In addition to materials listed above, vertical waste piping from lavatories, sinks, and drinking fountains may be any of the following:
 - a. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - b. Copper DWV tube, copper drainage fittings, and soldered joints.
 5. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

3. 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.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 22 13 19.13
SANITARY DRAINS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Floor drains.

1.02 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.02 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products specified on Drawings, or comparable product by one of the following:
 - a. Josam Company.
 - b. Watts.
 - c. Zurn.
 - d. Or equal.
 - 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. Backwater Valve: Not required.
 - 10. Coating on Interior and Exposed Exterior Surfaces: Manufacturer's standard coating.
 - 11. Strainer Types by Drain Location: Refer to schedule on Drawings.
 - 12. Top or Strainer Material: Nickel bronze.
 - 13. Top of Body and Strainer Finish: Polished Nickel bronze.
 - 14. Top Shape: Round or Square.
 - 15. Top Loading Classification: Medium Duty.

16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
17. Trap Material: Cast iron or Copper.
18. Trap Pattern: Standard P-trap.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.02 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. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.

3.03 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. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 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

SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Roof flashing assemblies.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.02 ACTION SUBMITTALS

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

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

2.02 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk or raised-head, brass or cast-iron 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, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M for [adjustable housing] [cast-iron soil pipe with cast-iron ferrule] [heavy-duty, adjustable housing] [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: Inside calk or Spigot.
 8. Closure: Brass plug with straight threads and gasket.
 9. Adjustable Housing Material: Cast iron with threads.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy <Insert material and finish>.
 11. Frame and Cover Shape: Round.
 12. Top Loading Classification: Medium Duty.
 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. Watts; a Watts Water Technologies company.
 - f. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 5. Closure Plug:
 - a. [Brass] or [Cast iron].
 - b. Countersunk or raised 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: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
- 7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.03 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Acorn Engineering Company.
 - b. Zurn Industries, LLC.
- 2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Low-Silhouette Vent Cap: With vandal-proof vent cap.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

- 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. 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 1 inch 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.

D. 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.

E. 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.

2.05 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Applications: 12 oz./sq. ft.
 2. Vent Pipe Flashing: 8 oz./sq. ft.
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.01 INSTALLATION

1. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. 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.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- G. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- H. 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.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- J. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- K. Install vent caps on each vent pipe passing through roof.
- L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 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.
- C. Ground equipment according to Section 260530 "Conduit and Wire."
- D. Connect wiring according to Section 260530 "Conduit and Wire."

3.03 FLASHING INSTALLATION

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.04 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

SECTION 22 14 13
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 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 334111 "Site Storm Drainage System" for storm drainage piping outside the building.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail storm drainage piping. 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 drainage piping will be attached or suspended from.
 - 2. Refer to Section 22 00 50, "Common Work Results for Plumbing Systems for additional requirements.
- B. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.05 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 Owner and Construction Manager no fewer than seven days in advance of proposed interruption of storm drainage service.
 - 2. Do not proceed with interruption of storm drainage service without Owner's and Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 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.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark and NSF certification mark.
 - 2. Standard: ASTM A 888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Couplings shall bear CISPI collective trademark and NSF certification mark.
 - 3. Standards: ASTM C 1277 and CISPI 310.
 - 4. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Clamp-All Corp.
 - d. Ideal Clamp Products, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company, LLC; a division of MCP Industries.
 - g. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Standard: ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - 4) Plastic Oddities.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - 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.

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-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) GPT; an EnPro Industries company.
 - b. 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.
3. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Grinnell Mechanical Products.
 - 2) Matco-Norca.
 - 3) Precision Plumbing Products.
 - 4) Victaulic Company.
 - b. Description: Electroplated steel nipple.
 - c. Standard: IAPMO PS 66.
 - d. Pressure Rating: 300 psig at 225 deg F.
 - e. End Connections: Male threaded or grooved.
 - f. Lining: Inert and noncorrosive, propylene.

2.04 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Natural.

PART 3 - EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earthwork."

3.02 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 22 05 48 "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 or 2 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Storm Drainage Piping: 1 or 2 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. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."
 2. Install drains in storm drainage gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 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. Threaded Joints: Thread pipe with tapered pipe threads according to 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.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

3.06 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.

3.07 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.08 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. Maintain such pressure without leakage for four hours. 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. Piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.09 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.

3.10 PIPING SCHEDULE

- A. Aboveground storm drainage piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
 - a. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints shall be installed where piping will be located over critical areas including food preparation, food storage, and food serving.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- B. Underground storm drainage piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 22 14 23
STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
- B. Related Requirements:
 - 1. Section 07 62 00 "Sheet Metal Flashing and Trim" for penetrations of roofs.
 - 2. Section 07 84 00 "Firestopping" for firestopping roof penetrations.

1.02 SUBMITTALS

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

1.03 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. Watts; a Watts Water Technologies company.
 - f. Zurn Industries, LLC.
 - 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: Required.
 - 6. Flow-Control Weirs: Not required.
 - 7. Outlet: Bottom.

8. Outlet Type: No hub.
 9. Extension Collars: Not required.
 10. Underdeck Clamp: Required
 11. Expansion Joint: Not required.
 12. Sump Receiver Plate: Required.
 13. Dome Material: Cast iron.
 14. Perforated Gravel Guard: Not required.
 15. Vandal-Proof Dome: Required.
 16. Water Dam: 2 inches high on overflow drain.
- B. Cast-Iron, Medium-Sump, Roof Receptors:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Zurn Industries, LLC.
 2. Standard: ASME A112.6.4.
 3. Body Material: Cast iron.
 4. Dimension of Body: 8- to 12-inch diameter.
 5. Combination Flashing Ring and Gravel Stop: Required.
 6. Flow-Control Weirs: Not required.
 7. Outlet: Bottom.
 8. Outlet Type: No hub.
 9. Extension Collars: Not required.
 10. Underdeck Clamp: Required.
 11. Expansion Joint: Not required.
 12. Sump Receiver Plate: Required.
 13. Bottom strainer with stainless steel vandal proof screws.
 14. Water Dam: 2 inches high.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Conductor Nozzles:
1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
 2. Size: Same as connected conductor.

2.03 CLEANOUTS

- A. Floor Cleanouts:

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. Smith, Jay R. Mfg. Co.
 - b. Tyler Pipe; a subsidiary of McWane Inc.
 - c. Watts; a Watts Water Technologies company.
 - d. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M, for threaded, adjustable housing cleanouts.
 3. Size: Same as connected branch.
 4. Type: Threaded, adjustable housing.
 5. Body or Ferrule Material: Cast iron.
 6. Clamping Device: Not Required.
 7. Outlet Connection: Inside call.
 8. Closure: Brass plug with straight threads and gasket.
 9. Adjustable Housing Material: Cast iron with threads.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 11. Frame and Cover Shape: Round.
 12. Top-Loading Classification: Extra-Heavy Duty.
 13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.
- B. Test Tees:
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. MIFAB, Inc.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; a subsidiary of McWane Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
 3. Size: Same as connected drainage piping.
 4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, 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.
- C. Wall Cleanouts:
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. MIFAB, Inc.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; a subsidiary of McWane Inc.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
 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.
 7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.04 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install roof drains at low points of roof areas according to 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 conductor nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping according to 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 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install test tees in vertical conductors and near floor.
- G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.04 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

SECTION 22 34 00
FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.02 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.04 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/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
 - 1. Comply with efficiency requirements in ASHRAE 189.1, which supersede requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. 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.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."
- E. Water Heater shall comply with the Low-NOx requirements of SCAQMD rule 1146.2, for less than 14 ng/j, or 20 ppm.

1.05 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, 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, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: One year(s).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.02 COMMERCIAL, POWER-BURNER, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Power Burner, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. Bradford White Corporation.
 - b. PVI Industries, LLC.
 - c. Smith, A. O. Corporation.
 - 2. Standard: ANSI Z21.10.3/CSA 4.3.
 - 3. Description: Manufacturer's proprietary design to provide at least 80 percent thermal efficiency at optimum operating conditions.
 - 4. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Lining: Glass complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 - 5. Factory-Installed Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: UL 795 for power-burner, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
6. Draft Hood: Draft diverter, complying with ANSI Z21.12.
- B. Capacity and Characteristics: Refer to schedules on Drawings.

2.03 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Compression Tanks:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. Honeywell Water Controls.
 - b. Pentair Pump Group.
 - 2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber bladder. Include air precharge to minimum system-operating pressure at tank.
 - 3. 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 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - 4. Capacity and Characteristics:
 - a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: Refer to schedule on Drawings.
 - c. Air Precharge Pressure.

- 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. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Comply with requirements for ball or butterfly type shutoff valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
 - 1. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- G. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

2.04 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 45 00 "Quality Control" for retesting, reinspecting, and correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
- B. Install domestic-water heaters level and plumb, according to 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 22 05 23 "General-Duty Valves for Plumbing Piping."

- C. Install gas-fired, domestic-water heaters according to NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 23 11 23 "Facility Natural-Gas Piping."
- D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- E. Install double-wall vent. Refer to Section 23 51 23, "Gas Vents."
- F. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-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 sink.
- G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor sinks. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- H. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- J. Fill domestic-water heaters with water.
- K. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 23 11 23 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

- A. 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.
 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 proper operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Specifications for retesting and reinspecting requirements and Division 01 Specifications for correcting the Work.
- C. Prepare test and inspection reports.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Provide minimum 2 hours training.

END OF SECTION

SECTION 22 42 13.13
COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.
 - 4. Supports.

1.02 DEFINITIONS

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.
- C. Related Requirements:

1.03 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, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.05 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: No fewer than one of each type.

PART 2 - PRODUCTS

2.01 WALL-MOUNTED WATER CLOSETS

- A. Water Closets: Wall mounted, top spud, standard and accessible.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. American Standard America.

2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Standard.
 - f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gal. per flush.
 - h. Spud Size and Location: NPS 1-1/2; top.
3. Flushometer Valve: Refer to article, Flushometer Valves.
4. Toilet Seat: Refer to article, Toilet Seats.
5. Support: Water closet carrier.
6. Water-Closet Mounting Height: Refer to schedule on Drawings.

2.02 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. Zurn Industries, LLC.
 2. Standard: ASSE 1037.
 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. Exposed Flushometer-Valve Finish: Chrome plated.
 7. Panel Finish: Chrome plated or stainless steel.
 8. Style: Exposed.
 9. Minimum Inlet: NPS 1.
 10. Minimum Outlet: NPS 1-1/4.

2.03 TOILET SEATS

- A. Toilet Seats:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. American Standard America.
 - b. Bemis Manufacturing Company.
 - c. Kohler Co.
 - d. Olsonite Seat Co.
 2. Standard: IAPMO/ANSI Z124.5.

3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: .
6. Hinge: Self-sustaining.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

2.04 SUPPORTS

A. Water Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water supply 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.

3.02 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at adult mounting height, according to CBC 11B.

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 wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

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 that are easy for people with disabilities to reach.
- 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 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."

3.03 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.

3.04 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.

3.05 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

SECTION 22 42 13.16
COMMERCIAL URINALS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Urinals.
 - 2. Flushometer valves.
 - 3. Supports.

1.02 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, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.04 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: No fewer than one of each type.

PART 2 - PRODUCTS

2.01 WALL-HUNG URINALS

- A. Urinals: Wall hung, back outlet, washout, accessible.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. American Standard America.
 - b. Zurn Industries, LLC.
 - 2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Washout with extended shields.
 - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.

- e. Water Consumption: Low.
 - f. Spud Size and Location: NPS 3/4, top.
 - g. Outlet Size and Location: NPS 2, back.
 - h. Color: White.
3. Flushometer Valve: Refer to article, Flushometer Valves..
 4. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - b. Size: NPS 2.
 5. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture..
 6. Urinal Mounting Height: Refer to Drawings.

2.02 URINAL FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. Zurn Industries, LLC.
 2. Standard: ASSE 1037.
 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. Exposed Flushometer-Valve Finish: Chrome plated.
 7. Panel Finish: Chrome plated or stainless steel.
 8. Style: Exposed.
 9. Consumption: 0.125 gal. per flush.
 10. Minimum Inlet: NPS 3/4.
 11. Minimum Outlet: NPS 3/4.

2.03 SUPPORTS

- A. Type I Urinal Carrier:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Jay R. Smith Mfg. Co.
 - b. Zurn Industries, LLC.
 2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Urinal Installation:
 - 1. Install urinals level and plumb according to roughing-in drawings.
 - 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
 - 3. Install accessible, wall-mounted urinals at adult mounting height, according to CBC 11B.
- B. Support Installation:
 - 1. Install supports, affixed to building substrate, for wall-hung urinals.
 - 2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- C. Flushometer-Valve Installation:
 - 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
 - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
- D. 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."
- E. 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."

3.03 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.

3.04 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.

3.05 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

SECTION 22 42 16.13
COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Lavatories.
 - 2. Faucets.
 - 3. Supports.

1.02 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, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.
- C. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1.05 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.

1.06 QUALITY ASSURANCE

- A. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party

certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

PART 2 - PRODUCTS

2.01 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory: Vitreous china, wall mounted, with back.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. American Standard America.
 - 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Faucet-Hole Punching: Three holes, 4-inch centers.
 - d. Faucet-Hole Location: Top.
 - e. Color: White.
 - f. Mounting Material: Chair carrier.
 - 3. Faucet: Refer to article, "Solid-Brass, Manually Operated Faucets".
 - 4. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
 - 5. Lavatory Mounting Height: Refer to Drawings.

2.02 SOLID-BRASS, MANUALLY OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Manual-type, single-control mixing two-handle mixing, commercial, solid-brass valve.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. American Standard America.
 - 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: Centerset.
 - 5. Body Material: Commercial, solid brass.
 - 6. Finish: Polished chrome plate.
 - 7. Maximum Flow Rate: 0.5 gpm.
 - 8. Maximum Flow: 0.25 gal. per metering cycle.
 - 9. Mounting Type: Deck, exposed.
 - 10. Valve Handle(s): Push button.
 - 11. Spout: Rigid type.

12. Spout Outlet: Aerator.
13. Operation: Compression, manual.
14. Drain: Not part of faucet.

2.03 SUPPORTS

- A. Type II Lavatory Carrier:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Wade Drains.
 - d. Watts; a Watts Water Technologies company.
 - e. Zurn Industries, LLC.
 2. Standard: ASME A112.6.1M.

2.04 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," 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 female threaded inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 1. NPS 1/2.
 2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser, integral to faucet.

2.05 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 1. Size: NPS 1-1/2 by NPS 1-1/4.
 2. Material: 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. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.06 SUPPORTS

- A. Type II Lavatory Carrier:
 - 1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 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 walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at adult mounting height, according to CBC 11B.
- 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."

3.03 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."

3.04 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.05 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

**SECTION 22 42 16.16
COMMERCIAL SINKS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Service basins.
 - 2. Stainless Steel Sinks.
 - 3. Sink faucets.
 - 4. Continuous-feed disposers.
 - 5. Supply fittings.
 - 6. Waste fittings.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.
- C. Maintenance data.

1.03 QUALITY ASSURANCE

- A. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

PART 2 - PRODUCTS

2.01 SERVICE BASINS

- A. Service Basins: Terrazzo, floor mounted.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Fiat Products.
 - b. Florestone Products Co., Inc.
 - 2. Fixture:
 - a. Standard: IAPMO PS 99.
 - b. Shape: Radial front.
 - c. Height: 12 inches with dropped front.

- d. Tiling Flange: On two sides.
 - e. Rim Guard: On front top surfaces.
 - f. Drain: Grid with NPS 3 outlet.
3. Mounting: On floor and flush to wall.
 4. Faucet: F-1. Refer to article, Sink Faucets.

2.02 STAINLESS STEEL SINKS

- A. Kitchen Sinks: One bowl, counter mounted, stainless steel.
 1. Stainless-Steel Sinks:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - 1) Elkay Manufacturing Co.
 - 2) Just Manufacturing.
 2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel sinks.
 - b. Metal Thickness: [0.038 inch] [0.050 inch] <Insert dimension>.
 - c. Bowl:
 - 1) Dimensions: Refer to schedules on Drawings.
 - d. Faucet: F-2. Refer to article, Sink Faucets.
 3. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
 4. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.

2.03 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets : Manual type, two-lever-handle mixing valve.
 1. Commercial, Solid-Brass Faucets (Service Basins) F-1:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Speakman Company.
 - 2) T & S Brass and Bronze Works, Inc.
 - b. Standard: ASME A112.18.1/CSA B125.1.
 - c. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
 - d. Body Type: Widespread.
 - e. Body Material: Commercial, solid brass.
 - f. Finish: Chrome plated.
 - g. Maximum Flow Rate: 2.2 gpm.

- h. Handle(s): Lever.
 - i. Mounting Type: Back/wall, exposed.
 - j. Spout Type: Rigid, solid brass with wall brace and pail hook.
 - k. Vacuum Breaker: Required for hose outlet.
 - l. Spout Outlet: Aerator.
2. Commercial, Solid-Brass Faucets (Stainless Steel Sinks) F-2.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) American Standard America.
 3. Standard: ASME A112.18.1/CSA B125.1.
 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 5. Finish: Polished chrome plate.
 6. Mixing Valve: Two-lever handle.
 7. Centers: 8 inches.
 8. Mounting: Deck, exposed.
 9. Handle(s): Wrist blade, 4 inches.
 10. Spout Type: Rigid/swing gooseneck.
 11. Spout Outlet: Aerator.
 12. Drain: Not a part of faucet.

2.04 CONTINUOUS-FEED DISPOSERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 1. KitchenAid; a division of Whirlpool Corporation.
- B. Standards: ASSE 1008 and UL 430, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. General: Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
- D. Model: Sound-insulated chamber.
- E. Motor: 115-V ac, 1725 rpm, with overload protection.

2.05 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," 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 female threaded inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 1/2
 - 2. Chrome-plated, rigid-copper pipe.

2.06 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2.
 - 2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water supply 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.

3.02 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at adult mounting height according to CBC 11B.
- 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 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."

- I. Install disposer in outlet of each sink indicated to have a disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

3.03 CONNECTIONS

- A. Connect sinks 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."

3.04 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.05 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

SECTION 22 47 16
PRESSURE WATER COOLERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes pressure water coolers and related components.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.
- C. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.03 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.04 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: One for each installed unit.

1.05 QUALITY ASSURANCE

- A. California Health and Safety Code Compliance: HSC 116875 for pressure water coolers. Pressure water coolers shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

PART 2 - PRODUCTS

2.01 PRESSURE WATER COOLERS

- A. Pressure Water Coolers: Flush to wall.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - 2. Standards:

- a. Comply with NSF 61 Annex G.
- b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
3. Cabinet: All stainless steel.
4. Receptor(s):
 - a. Number: Two.
 - b. Material: Stainless steel.
 - c. Shape: Rounded front.
 - d. Bubbler: One for each receptor, with adjustable stream regulator.
5. Drain: Grid type with NPS 1-1/4 tailpiece.
6. Bubbler: One for each receptor, with adjustable stream regulator, located on deck.
7. Control: Push button.
8. Drain: Grid with NPS 1-1/4 tailpiece.
9. Supply: NPS 3/8 with shutoff valve.
10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
11. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards, with capacity sized for unit peak flow rate.
12. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 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.
13. Capacities and Characteristics:
 - a. Cooled Water: 8 gph.
 - b. Ambient-Air Temperature: 90 deg F.
 - c. Inlet-Water Temperature: 80 deg F.
 - d. Cooled-Water Temperature: 50 deg F.

2.02 SUPPORTS

- A. Refer to schedule on Drawings.

PART 3 - EXECUTION

3.01 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.

3.02 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."

3.03 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. 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."

3.04 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.05 CLEANING

- A. After installing fixture, 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

SECTION 23 00 50
COMMON WORK RESULTS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all Division 23 Sections.

1.02 RELATED REQUIREMENTS

- A. This Section is a part of each Division 23 Section.

1.03 ADDITIONAL REQUIREMENTS

- A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.
- B. Make all temporary connections required to maintain services, including adequate heat and cooling, during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before disrupting services.
- C. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.

1.04 REFERENCES AND STANDARDS

- A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.
 - 1. AABC - Associated Air Balance Council
 - 2. AFBMA - Anti Friction Bearing Manufacturer's Association
 - 3. AMCA - Air Moving and Control Association Inc.
 - a. Standard 210 - Laboratory Methods of Testing Fans
 - 4. ANSI - American National Standards Institute
 - 5. ARI - Air-Conditioning and Refrigeration Institute
 - 6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 - 7. ASME - American Society of Mechanical Engineers
 - 8. ASTM - American Society for Testing and Materials
 - 9. CCR - California Code of Regulations
 - a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36
 - 10. CSA – Canadian Standards Association International
 - 11. CSFM - California State Fire Marshal
 - 12. NCPWB - National Certified Pipe Welding Bureau
 - 13. NIST - National Institute of Standards and Technology
 - 14. NEMA - National Electrical Manufacturers' Association

15. NFPA - National Fire Protection Association
 16. OSHA - Occupational Safety and Health Act
 17. SMACNA - Duct Manuals
 18. UL - Underwriters' Laboratories, Inc.
- B. Requirements of Regulatory Agencies:
1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
 2. Code editions shall be as noted on Drawings, as adopted by the California Division of the State Architect (DSA).
 - a. California Building Code.
 - b. California Electrical Code.
 - c. California Energy Code.
 - d. California Fire Code.
 - e. California Green Building Standards Code.
 - f. California Mechanical Code.
 - g. California Plumbing Code.
 - h. California Code of Regulations, Title 24.
 - i. California Health and Safety Code.
 - j. CAL-OSHA.
 - k. California State Fire Marshal, Title 19 CCR.
 - l. National Fire Protection Association.
 - m. Occupational Safety and Health Administration.
 - n. Other applicable state laws.
 3. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

1.05 DRAWINGS

- A. Examine Contract Documents prior to bidding of work and report discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The HVAC Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
 1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over HVAC Drawings.
 2. Because of the small scale of HVAC Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and

arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.

3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contactors' expense upon Architects' direction.
 4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.
- C. Execute work mentioned in the Specifications and not shown on the Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.06 FEES AND PERMITS

- A. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.

1.07 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 1. Submittals shall be submitted in accordance with the requirements of Division 01 Specifications.
 2. Closeout Submittals shall be submitted in accordance with the requirements of Division 01 Specifications.
- B. Coordination:
 1. General:
 - a. Coordinate HVAC Work with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.
 2. Have fire damper and fire smoke damper installation instructions available at Project site during construction for use by Project Inspector.
 3. Electrical Coordination:
 - a. Refer to Section 26 05 30, "Conduit and Wire," for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
 - 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
 - 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.

- 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.
4. Mechanical Coordination:
 - a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
 - b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during construction.
 - c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces.
 - d. Coordinate with other trades equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to other trades as required for a completely coordinated project.

1.08 SUBMITTALS - GENERAL

- A. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.
- B. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used. Refer to Division 01 for complete instructions.
 1. Partial or incomplete submittals will not be considered.
 2. Quantities are Contractor's responsibility and will not be reviewed.
 3. Provide materials of the same brand or manufacturer for each class of equipment or material.
 4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
 5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
 6. Organize submittals in same sequence as in Specification Sections.
 7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
 - a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
 - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
 - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of

Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.

- d. Catalog cuts and published material may be included with supplemental scaled drawings.
- C. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.
- D. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal as a complete package.
 - 1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.
- E. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

1.09 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing systems materials and products.
- B. Shop Drawings.
- C. Provide product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. Sustainable Design Submittals:
 - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.

1.10 INFORMATIONAL SUBMITTALS

- A. Provide coordinated layouts for HVAC systems, in accordance with Specification Section 23 31 13, "Metal Ducts."
- B. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

1. Refer to Section 01 78 50, Operating and Maintenance Data, for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
 2. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Begin compiling data upon approval of submittals.
 - a. Sets shall incorporate the following:
 - 1) Product Data.
 - 2) Shop Drawings.
 - 3) Record Drawings.
 - 4) Service telephone number, address and contact person for each category of equipment or system.
 - 5) Complete operating instructions for each item of heating, ventilating and air conditioning equipment.
 - 6) Copies of guarantees/warranties for each item of equipment or systems.
 - 7) Test data and system balancing reports.
 - 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
 - 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
 - 10) Temperature control diagrams and literature.
 - 11) Check test and start reports for each piece of mechanical equipment provided as part of the Work.
 - 12) Commissioning and Preliminary Operation Tests required as part of the Work.
 3. Post service telephone numbers and addresses in an appropriate place designated by Architect.
- B. Record Drawings:
1. Refer to Section 01 78 20, Project Record Documents, for requirements governing Work specified herein.
 2. Upon completion of the Work, deliver to Architect the following:
 - a. Originals of drawings showing the Work exactly as installed.
 - b. One complete set of reproducible drawings showing the Work exactly as installed.
 - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
 - d. Provide Contractor's signature, verifying accuracy of record drawings.
 - e. Obtain the signature of the Project Inspector of Record for Record Drawings.

1.12 SUBSTITUTIONS

- A. Refer to Division 01 Specifications, for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be manufacturers other than those specifically listed in the Contract Documents by brand name, model, or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:
 - 1. Reason for substitution request.
 - 2. Complete submittal information as described herein; see "Submittals."
 - 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
 - 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
 - 5. Explanation of impact on connected utilities.
 - 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.
- G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

1.13 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of HVAC systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with HVAC systems work similar to that required for this Project.
- C. Comply with applicable portions of California Mechanical Code pertaining to selection and installation of HVAC materials and products.
- D. All materials and products shall be new.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.15 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies

to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.

- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

1.16 WARRANTY

- A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.
- B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.
- C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.
- C. Refer to Division 23 technical Sections for specific system piping materials.

2.02 MATERIALS

- A. No material installed as part of this Work shall contain asbestos.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
- C. California Green Building Code Compliance:
 - 1. HVAC and refrigeration equipment shall not contain CFCs.
 - 2. HVAC and refrigeration equipment shall not contain Halons.

2.03 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Provide magnetic motor starters for all equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.
 - 1. All starters shall have the following:

- a. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
 - b. Ambient compensated thermal overload.
 - c. Fused control transformer (for 120 or 24 volt service).
 - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIIR enclosures.
2. Where three phase motors are provided for two-speed operation, provide two speed motor starters.
 3. Starters for single-phase motors shall have thermal overloads. NEMA I enclosure for starters located indoors, NEMA IIIIR enclosure for starters located outdoors.
 4. Provide OSHA label indicating the device starts automatically.

2.04 VALVE BOXES

- A. General:
 1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
 2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
 3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or approved equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
- C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or approved equal, 8 inches inside diameter by 30 inches long, with cast iron locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
- D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or approved equal, with extension to suit conditions.

2.05 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
 1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Section 08 31 00, "Access Doors and Panels," except as noted in this Section.
- C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.

- D. Where panels are located on ducts or plenums, provide neoprene gaskets to prevent air leakage, and use frames to set door out to flush with insulation.
- E. Provide insulated doors where located in internally insulated ducts or casings.
- F. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.
- G. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.
- H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
 - 1. Milcor
 - a. Style K (plaster).
 - b. Style DW (gypsum board).
 - c. Style M (Masonry).
 - d. Style "Fire Rated" where required.

PART 3 - EXECUTION

3.01 FRAMING, CUTTING AND PATCHING

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.
- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.

3.02 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

3.03 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic 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 coordination drawings.

3.04 INSTALLATION OF PIPING AND DUCT SYSTEMS

A. General:

1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
3. Install piping to permit application of insulation and to allow valve servicing.
4. Where piping, conduit, or ductwork is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
5. Horizontal runs of pipes, conduits, or ductwork suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
7. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, all duct and other related air distribution component opening shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency.
8. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
9. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.
10. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
11. Install horizontal valves with valve stem above horizontal.
12. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
13. Verify final equipment locations for roughing-in.
14. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

3.05 ACCESS DOORS

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.06 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Refer to Structural Drawings.

3.07 OPERATION OF SYSTEMS

- A. Do not operate any mechanical equipment for any purpose, temporary or permanent, until all of the following has been completed:
 - 1. Complete all requirements listed under “Check, Test and Start Requirements.”
 - 2. Ductwork and piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
 - 3. Filters, strainers etc. are in place.
 - 4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
 - 5. Equipment has been run under observation, and is operating in a satisfactory manner.
- B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.
- C. Operate every fire damper, smoke damper, combination smoke and fire damper under normal operating conditions. Activate smoke detectors as required to operate the damper, stage fan, etc. Provide written confirmation that all systems operate in a satisfactory manner.

3.08 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of mechanical equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
 - 1. As part of the submittal process, provide a copy of each manufacturer’s printed startup form to be used.
 - 2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer’s employees. See specific equipment Articles in these Specifications for this requirement.
 - 3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
 - 4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each Operation and Maintenance Manual. Provide a copy of certification from the Owner’s representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

3.09 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put HVAC, plumbing, and fire protection systems into service and check that work required for that purpose has been done, including

but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.

1. Refer to Division 22 technical Sections for specific testing requirements.
 2. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations, including modulating power exhausts if present.
 3. Correct rotation of motors and ratings of overload heaters are verified.
 4. Specified filters are installed and spare filters have been turned over to Owner.
 5. All manufacturers' certificates of start-up specified have been delivered to the Owner.
 6. All equipment has been cleaned, and damaged painted finishes touched up.
 7. Damaged fins on heat exchangers have been combed out.
 8. Missing or damaged parts have been replaced.
 9. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.
 10. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
 11. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
 12. Preliminary test and balance work is complete, and reports have been forwarded for review.
 13. Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.
 14. Operation and Maintenance Manuals have been delivered and instructions to the operating personnel have been made.
- B. Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.
1. Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.
 2. Include operation of heating and air conditioning equipment and systems for a period of not less than two 8 hour days at not less than 90 percent of full specified heating and cooling capacities in tests.
 3. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.
 4. During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.
 5. Where Utility District rebates are applicable, demonstrate that the systems meet the rebate program requirements.
- C. Before handing over the system to Owner replace all filters with complete new set of filters.
- D. Review of Contractor's Tests:

1. All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide a report to confirm that all testing has been successful.
- E. Test Logs:
1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.
- F. Preliminary Operation:
1. The Owner reserves the right to operate portions of the mechanical system on a preliminary basis without voiding the guarantee.
- G. Operational Tests:
1. Before operational tests are performed, demonstrate that all systems and components are complete and fully charged with operating fluid and lubricants.
 2. Systems shall be operable and capable of maintaining continuous uninterrupted operation during the operating and demonstration period. After all systems have been completely installed, connections made, and tests completed, operate the systems continuously for a period of five working days during the hours of a normal working day.
 3. This period of continuous systems operation may be coordinated with the removal of Volatile Organic Compounds (VOCs) from the building prior to occupancy should the Owner decide to implement such a program.
 4. Control systems shall be completely operable with settings properly calibrated and adjusted.
 5. Rotating equipment shall be in dynamic balance and alignment.
 6. If the system fails to operate continuously during the test period, the deficiencies shall be corrected and the entire test repeated.
- H. Pre-Occupancy Building Purge:
1. Prior to occupancy, ventilate the building on 100 percent outside air, 100 percent exhaust for a continuous period determined by a qualified industrial hygienist (engaged by the Contractor) to reduce V.O.C's prior to occupancy.
 2. Submit report by the industrial hygienist verifying satisfactory completion of the pre-occupancy purge.

3.10 CERTIFICATES OF INSTALLATION

- A. Contractor shall complete applicable "Certificates of Installation" forms contained in the California Building Energy Efficiency Standards and submit to the authorities having jurisdiction for approval and issuance of final occupancy permit, as described in the California Energy Code.

3.11 ACCEPTANCE REQUIREMENTS

- A. Contractor shall complete the applicable Acceptance Requirements for Code Compliance contained in the California Building Energy Efficiency Standards. Refer to T-24 compliance forms on Drawings for systems having Acceptance testing requirements. Contractor shall perform Acceptance tests under the direction of the Commissioning Agent and complete the appropriate "Certificates of Acceptance." Submit certificates to the authorities having jurisdiction for

approval and issuance of final occupancy permit. Contractor shall engage certified HERS Rater to verify duct leakage rate for duct systems indicated on T-24 compliance forms on Drawings as requiring duct leakage rate testing. For additional duct leak testing requirements, refer to Section 23 31 13, "Metal Ducts.

3.12 DEMONSTRATION AND TRAINING

- A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
 2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
 3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
 - a. Listing of Owner-designated personnel completing training, by name and title.
 - b. Name and title of training instructor.
 - c. Date(s) of training.
 - d. List of topics covered in training sessions.
 4. Refer to specific equipment Sections for minimum training period duration for each piece of equipment.

3.13 COMMISSIONING

- A. This Project will be commissioned by a third-party Commissioning Agent. In addition to the requirements of this Section, comply with the requirements of Section 01 81 00, "Commissioning."

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 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.

1.02 SUBMITTALS

- A. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp.

1.03 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.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.02 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.

2.03 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 and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 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. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 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. Motors for HVAC exhaust, transfer, and supply fans larger than 1/12 hp and smaller than 1 hp shall be the following:
 - 1. Electrically Commutated motor (EC type): Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20 percent of full speed and 85 percent efficient at all speeds. These motors shall also have the means to adjust motor speed for either balancing or remote control. Exceptions:

- a. Motors in fan-coils and terminal units that operate only when providing heating to the space served.
- b. Motors installed in space conditioning equipment certified under 2016 California Energy Code Section 110.1 or 110.2.
- C. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- D. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- E. Motors 1/20 HP and Smaller: Shaded-pole type.
- F. 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

SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flexible-hose packless expansion joints.
 - 2. Alignment guides and anchors.
 - 3. Pipe loops and swing connections.

1.02 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.

1.03 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 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.

2.02 PACKLESS EXPANSION JOINTS

A. Rubber Union Connector Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Amber/Booth Company, Inc.; a VMC Group Company.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. General Rubber Corporation.
 - e. Mason Industries, Inc.
 - f. Proco Products, Inc.
 - g. Unaflex.
 - h. Unisource Manufacturing, Inc.
2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
4. End Connections for NPS 2 and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Metraflex Company (The). Metraflex Inc., Metraloop series.
 - b. 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. Provide assembly selected for 4 inches of movement.
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 threaded 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.
6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-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.

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.

2.03 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Mason Industries, Inc.
 - b. Metraflex Company (The).
 - c. Unisource Manufacturing, 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 A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, 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.

PART 3 - EXECUTION

3.01 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install rubber packless expansion joints according to FSA-PSJ-703.

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

- 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.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- 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

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
- B. Related Requirements:
 - 1. Section 078400 " Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, 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.

2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Advance Products & Systems, Inc.
 - 2. Airex Manufacturing.
 - 3. CALPICO, Inc.
 - 4. GPT; an EnPro Industries company.
 - 5. Metraflex Company (The).

6. Proco Products, 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.
 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 4. Pressure Plates: Carbon steel.
 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.03 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, 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.

PART 3 - EXECUTION

3.01 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, seal 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 sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200, "Joint Sealants."

- 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 078400 " Firestopping."

3.02 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.

3.03 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: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves.
 - 2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller Than NPS 6: Steel 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: Steel 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: Steel 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: Steel 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. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 23 05 18
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.02 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.

2.02 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 polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

2.03 FLOOR PLATES

- A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
 - c. Bare Piping in Unfinished Service Spaces: One-piece stamped steel with polished, chrome-plated finish.
 - d. Bare Piping in Equipment Rooms: One-piece stamped steel 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: Split floor plate.

3.02 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 23 05 19
METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Trerice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red 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.

2.02 THERMOWELLS

- A. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion in 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.

2.03 DIAL-TYPE PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Terice, H. O. Co.
 - b. Watts; a Watts Water Technologies company.
 - c. Weiss Instruments, Inc.
 - d. WIKA Instrument Corporation.
 - e. Winters Instruments - U.S.
 2. Standard: ASME B40.100.
 3. Case: Liquid-filled 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 1/4 or 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.

2.04 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.05 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Peterson Equipment Co., Inc.
 2. Trerice, H. O. Co.
 3. Watts; a Watts Water Technologies company.
 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion in 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: EPDM self-sealing rubber.

2.06 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Peterson Equipment Co., Inc.
 2. Trerice, H. O. Co.
 3. Watts; a Watts Water Technologies company.
 4. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), 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. 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.
- D. 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.
- E. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter 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 direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in piping tees.
- I. Install permanent indicators on walls or brackets in accessible and readable positions.
- J. Install connection fittings in accessible locations for attachment to portable indicators.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic boiler.
- L. Install pressure gages in the following locations:
 - 1. Suction and discharge of each pump.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic boiler shall be [**one of**] the following:
 - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
 - 1. Industrial-style, liquid-in-glass type.

- C. Thermometers at inlets and outlets of each hydronic coil at VAV boxes shall be the following:
 - 1. Test plug with EPDM self-sealing rubber inserts.
- D. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.06 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at suction and discharge of each pump shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

END OF SECTION

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Iron ball valves.
 - 4. Iron, single-flange butterfly valves.
 - 5. Iron, grooved-end butterfly valves.
 - 6. Bronze lift check valves.
 - 7. Bronze swing check valves.
 - 8. Iron swing check valves.
 - 9. Iron swing check valves with closure control.
 - 10. Iron, center-guided check valves.
 - 11. Bronze globe valves.
 - 12. Iron globe valves.
 - 13. Bronze gate valves
 - 14. Chainwheels.
- B. Related Sections:
 - 1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.02 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam working pressure.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.04 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- 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 handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.

- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Jenkins Valves; Crane Energy Flow Solutions.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.03 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Hammond Valve.
 - d. Lance Valves.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.

- g. Watts; a Watts Water Technologies company.
 - 2. Ends: Threaded.
 - 3. Seats: PTFE.
 - 4. Stem: Stainless steel.
 - 5. Ball: Stainless steel, vented.
 - 6. Port: Full.
- B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.04 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig.
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

2.05 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal::
 - a. ABZ Valve and Controls.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Spence Engineering Company, Inc.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.06 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

A. Iron, Grooved-End Butterfly Valves, 175 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Grinnell Mechanical Products.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire Products LP.
 - e. Victaulic Company.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

2.07 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts; a Watts Water Technologies company
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.08 IRON SWING CHECK VALVES

- A. Class 250, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.09 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Iron Swing Check Valves with Lever- and Spring-Closure Control, Class 125:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.

- g. Trim: Bronze.
 - h. Gasket: Asbestos free.
 - i. Closure Control: Factory-installed, exterior lever and spring.
- B. Iron Swing Check Valves with Lever and Weight-Closure Control, Class 125:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.
 - i. Closure Control: Factory-installed, exterior lever and weight.

2.10 IRON, CENTER-GUIDED CHECK VALVES

- A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 125:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze.

2.11 BRONZE GLOBE VALVES

- A. Bronze Globe Valves, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Hammond Valve.
 - c. KITZ Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts; a Watts Water Technologies company.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Bronze or PTFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.12 IRON GLOBE VALVES

- A. Iron Globe Valves, Class 250:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Hammond Valve.
 - c. Jenkins Valves; Crane Energy Flow Solutions.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Stockham; Crane Energy Flow Solutions.
 - g. Watts; a Watts Water Technologies company.
 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.

- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.
- g. Operator: Handwheel or chainwheel.

2.13 BRONZE GATE VALVES

- A. Bronze Gate Valves, RS, Class 125:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts; a Watts Water Technologies company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.14 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball and butterfly valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 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.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. Use gate valves only where shown on Drawings. Include hose-end connection if applicable for drain service.
- B. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: Butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

- b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- D. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 5. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Ball Valves: Two-piece, full port, bronze or brass with stainless-steel trim.
 - 2. Bronze Swing Check Valves: Class 125, bronze disc.
 - 3. Bronze Globe Valves: Class 150, bronze or nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 125.
 - 3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 150 CWP, EPDM seat, aluminum-bronze disc.
 - 4. Iron Swing Check Valves: Class 250, metal seats.
 - 5. Iron Globe Valves: Class 250.

3.06 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Ball Valves: Three piece, full port, bronze or brass with stainless-steel trim.
 - 2. Bronze Swing Check Valves: Class 150, bronze disc.
 - 3. Bronze Globe Valves: Class 150, bronze or nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
 - 3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.

5. Iron Swing Check Valves: Class 250, metal seats.
6. Iron Gate Valves: Class 250, NRS.
7. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250.

END OF SECTION

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

PART 1 - GENERAL

1.01 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. Equipment supports.
- B. Related Sections:
 - 1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 3. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
 - 4. Section 23 31 13 "Metal Ducts" for duct hangers and supports.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.03 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 HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to CBC and ASCE/SEI 7, as referenced by the CBC.
 - 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.
- C. All connections and attachments to the building structural systems will require review and approval for structural engineer of record.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. 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. Design Calculations: Calculate requirements for designing trapeze hangers.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 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 or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.02 TRAPEZE PIPE HANGERS

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

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. B-line, an Eaton business.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Unistrut; Part of Atkore International.
 - e. Wesanco, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 7. Metallic Coating: Electroplated zinc or hot-dipped galvanized.

2.04 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. Pipe Shields Inc.
 - 6. Piping Technology & Products, Inc.
 - 7. Rilco Manufacturing Co., Inc.
 - 8. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig 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.

2.05 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 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: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-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.

2.07 EQUIPMENT SUPPORTS

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

2.08 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth 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.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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 reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 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.

3.03 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.

3.04 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.

3.05 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 a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 91 23 "Interior Painting" and Section 09 96 00 "High Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of 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 Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. 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.
16. 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.
17. 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 might occur.
18. 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 might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. 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 might occur and vertical adjustment is not necessary.
 21. 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 might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 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.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches 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.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. 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.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. 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.

- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Open-spring isolators.
 - 2. Housed-spring isolators.
 - 3. Housed-restrained-spring isolators.
 - 4. Pipe-riser resilient supports.
 - 5. Resilient pipe guides.
 - 6. Spring hangers.
 - 7. Snubbers.
 - 8. Restraint channel bracings.
 - 9. Restraint cables.
 - 10. Seismic-restraint accessories.
 - 11. Mechanical anchor bolts.
 - 12. Vibration isolation equipment bases.
- B. Related Requirements:
 - 1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
 - 2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.02 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 2. 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 each vibration isolation and seismic-restraint device.
1. Calculations performed for use in selection of seismic supports, anchorages, and restraints shall utilize criteria indicated in Structural Contract Documents.
 2. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an OSHPD pre-approved system such as Tolco, ISAT, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
 - a. Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.
 3. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2016 California Building Code
 4. Additional Requirements: In addition to the above, conform to all state and local requirements.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: 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 and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the CBC 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 and shall bear anchorage preapproval OPM number from OSHPD showing maximum seismic-restraint ratings. For additional requirements, refer to article, Action Submittals.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. See structural documents for wind and seismic restraint loads.
- B. Rated strengths, features, and applications shall be as defined in reports by OSHPD or provide calculations, signed and sealed by a qualified structural engineer registered in the State of California.

2.02 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
 - 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.03 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.

- b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.04 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.05 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.06 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.07 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
 2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.08 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. Novia; A Division of C&P.
 - 4. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.09 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 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 and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.10 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 603 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.

2.11 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. B-line, an Eaton business.
 - 2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.
 4. TOLCO.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or 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.

2.12 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 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 E 488.

2.13 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. California Dynamics Corporation.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. Novia; A Division of C&P.
 5. Vibration Eliminator Co., Inc.
 6. Vibration Isolation.
 7. Vibration Mountings & Controls, Inc.
 - 8.
- B. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

- a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: 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.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD.
- 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 due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND 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. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by OSHPD that provides required submittals for component.
- E. Piping Restraints:
1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by OSHPD that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. 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.
- J. 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.
- K. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections. Comply with requirements in Section 23 05 16, "Expansion Fittings and Loops for HVAC Piping" for flexible-hose packless expansion joints for use at building seismic joints.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 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.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.06 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.

3.07 VIBRATION ISOLATION EQUIPMENT BASES 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."

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Brimar Industries, Inc.
 - b. Craftmark Pipe Markers.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.
 - 2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 3. Letter Color: White.
 - 4. Background Color: Black.

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 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-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Brimar Industries, Inc.
 - b. Craftmark Pipe Markers.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 7. 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-quarters the size of principal lettering.
 8. Fasteners: Stainless-steel rivets or self-tapping screws.
 9. 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.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Brimar Industries, Inc.

2. Craftmark Pipe Markers.
 3. Marking Services Inc.
 4. National Marker Company.
 5. Seton Identification Products.
 6. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - C. Letter Color: Red.
 - D. Background Color: Yellow.
 - E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - G. 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-quarters the size of principal lettering.
 - H. Fasteners: Stainless-steel rivets or self-tapping screws.
 - I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
 - J. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Services Inc.
 4. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to 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 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: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.04 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Carlton Industries, LP.
 - 4. Champion America.
 - 5. Craftmark Pipe Markers.
 - 6. emedco.
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Sevices Inc.
 - 10. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include 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.

2.05 STENCILS

- A. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Brimar Industries, Inc.
 - b. Carlton Industries, LP.

- c. Champion America.
 - d. Craftmark Pipe Markers.
 - e. Kolbi Pipe Marker Co.
 - f. Marking Sevices Inc.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
 3. Stencil Material: Aluminum.
 4. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 5. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.06 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Sevices Inc.
 4. Seton Identification Products.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link chain or beaded chain.
- 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. Valve-tag schedule shall be included in operation and maintenance data.

2.07 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Sevices Inc.
 4. Seton Identification Products.
- B. Description: 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 minimum.
 2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.01 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 encapsulants.

3.02 GENERAL INSTALLATION 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.

3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings."
- B. 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. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations and on both sides of 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. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
 1. Chilled-Water Piping: White letters on a safety-green background.

2. Heating Water Piping: White letters on a safety-green background.
3. Refrigerant Piping: Black letters on a safety-orange background.

3.05 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.06 VALVE-TAG INSTALLATION

- 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches, round.
 - b. Refrigerant: 1-1/2 inches, round.
 - c. Hot Water: 1-1/2 inches, round.
 - d. Gas: 1-1/2 inches, round.
 2. Valve-Tag Colors:
 - a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
 - b. Flammable Fluids: Black letters on a safety-yellow background.
 - c. Combustible Fluids: White letters on a safety-brown background.
 - d. Potable and Other Water: White letters on a safety-green background.
 - e. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.07 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - 3. Balancing Domestic Water Piping Systems.

1.02 REFERENCES

- A. Associated Air Balance Council (AABC)
 - 1. National Standards for Total System Balance, latest edition.

1.03 DEFINITIONS

- A. The intent of this Section is to use the standards pertaining to the TAB specialist engaged to perform the Work of this Contract, with additional requirements specified in this Section. Contract requirements take precedence over corresponding AABC or NEBB standards requirements. Differences in terminology between the Specifications and the specified TAB organization standards do not relieve the TAB entity engaged to perform the Work of this Contract of responsibility from completing the Work as described in the Specifications.
- B. Similar Terms: The following table is provided for clarification only:

<u>Similar Terms</u>	
Contract Term	AABC Term
TAB Specialist	TAB Agency
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems
TAB Field Supervisor	Test and Balance Engineer

- C. AABC: Associated Air Balance Council.
- D. TAB: Testing, adjusting, and balancing.
- E. TAB Organization: Body governing practices of TAB Specialists.

- F. TAB Specialist: An entity engaged to perform TAB Work.

1.04 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.
 - 1. Provide list of similar projects completed by proposed TAB field supervisor.
 - 2. Provide copy of completed TAB report, approved by mechanical engineer of record for a completed project with similar system types and of similar complexity.
- 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.
 - 1. Submit examinations report with qualifications data.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Interim Reports. Submit interim reports as specified in Part 3. Include list of system conditions requiring correction and problems not identified in Contract Documents examination report.
- E. Certified TAB reports.
 - 1. Provide three printed copies of final TAB report. Provide one electronic file copy in PDF format.
- F. Sample report forms.
- G. 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.
 - a. Instruments to be used for testing and balancing shall have been calibrated within a period of one year, or less if so recommended by instrument manufacturer and be checked for accuracy prior to start of work.

1.05 QUALITY ASSURANCE

- A. Independent TAB Specialist Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. The certification shall be maintained for the entire duration of TAB work for this Project. If TAB specialist loses certification during this period, the Contractor shall immediately notify the Architect and submit another TAB specialist for approval. All work specified in this Section and in other related Sections performed by the TAB specialist shall be invalidated if the TAB specialist loses certification, and shall be performed by an approved successor.
- B. To secure approval for the proposed TAB specialist, submit information certifying that the TAB specialist is either a first-tier subcontractor engaged and paid by the Contractor, or is engaged and paid directly by the Owner. TAB specialist shall not be affiliated with any other entity

participating in Work of this Contract, including design, furnishing equipment, or construction. In addition, submit evidence of the following:

1. TAB Field Supervisor: Full-time employee of the TAB specialist and certified by AABC.
 - a. TAB field supervisor shall have minimum 10 years supervisory experience in TAB work.
2. TAB Technician: Full-time employee of the TAB specialist and who is certified by AABC as a TAB technician.
 - a. TAB technician shall have minimum 4 years TAB field experience.
- C. TAB Specialist engaged to perform TAB work in this Project shall be a business limited to and specializing in TAB work, or in TAB work and Commissioning.
- D. TAB specialist engaged to perform TAB work shall not also perform commissioning activities on this Project.
- E. Certified TAB field supervisor or certified TAB technician shall be present at the Project site at all times when TAB work is performed.
 1. TAB specialist shall maintain at the Project site a minimum ratio of one certified field supervisor or technician for each non-certified employee at times when TAB work is being performed.
- F. Contractor shall notify Architect in writing within three days of receiving direction resulting in reduction of test and balance scope or other deviations from Contract Documents. Deviations from the TAB plan shall be approved in writing by the mechanical engineer of record for the Project.
- G. TAB Standard:
 1. Perform TAB work in accordance with the requirements of the standard under which the TAB agencies' qualifications are approved unless Specifications contain different or more stringent requirements:
 - a. AABC National Standards for Total System Balance.
 2. All recommendations and suggested practices contained in the TAB standard are mandatory. Use provisions of the TAB standard, including checklists and report forms, to the extent to which they are applicable to this Project.
 3. Testing, adjusting, balancing procedures, and reporting required for this Project, and not covered by the TAB standard applicable to the TAB specialist engaged to perform the Work of this Contract, shall be submitted for approval by the design engineer.
- H. TAB Conference: Meet with Architect and mechanical engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the project requirements. Require the participation of the TAB field supervisor. Provide seven days' advance notice of scheduled meeting time and location. TAB conference shall take place at location selected by Architect offices of Capital.
 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.

- d. Coordination of documentation and communication flow, including protocol for resolution tracking and documentation.
- 2. The requirement for TAB conference may be waived at the discretion of the mechanical engineer of record for the Project.
- I. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- J. TAB Report Forms: Use standard TAB specialist's forms approved by Architect.
- K. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- L. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- M. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.06 WARRANTY

- A. Provide workmanship and performance warranty applicable to TAB specialist engaged to perform Work of this Contract:
 - 1. AABC Performance Guarantee.
- B. Refer to Division 01 Specifications for additional requirements.

1.1 COORDINATION

- C. Notice: Provide seven days' advance notice for each test. 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 TAB work with work of other trades.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contract Documents Examination Report:
 - 1. TAB specialist shall review Contract Documents, including plans and specifications. Provide report listing conditions that would prevent the system(s) from operating in accordance with the sequence of operations specified, or would prevent accurate testing and balancing:
 - a. Identify each condition requiring correction using equipment designation shown on Drawings. Provide room number, nearest building grid line intersection, or other information necessary to identify location of condition requiring correction.

- b. Proposed corrective action necessary for proper system operation.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. 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.
- E. Examine equipment performance data including fan and pump curves.
 - 1. 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.
- 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 HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report conditions requiring correction discovered before and during performance of TAB procedures.
- P. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures. TAB plan shall be specific to Project and include the following:
 - 1. General description of each air system and sequence(s) of operation.
 - 2. Complete list of measurements to be performed.
 - 3. Complete list of measurement procedures. Specify types of instruments to be utilized and method of instrument application.
 - 4. Qualifications of personnel assigned to Project.
 - 5. Single-line CAD drawings reflecting all test locations (terminal units, grilles, diffusers, traverse locations, etc).

6. Table indicating pressure relationships (positive, negative, or neutral) between building spaces.
7. Air terminal correction factors for the following:
 - a. Air terminal configuration.
 - b. Flow direction (supply or return/exhaust).
 - c. Effective area of each size and type of air terminal.
 - d. Air density.
- B. Complete system-readiness checks and prepare 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. Balance, 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.

3.03 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 Total System Balance" and in this Section.
 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, 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.

3.04 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. Test each system to verify building or space operating pressure, including all stages of economizer cycle. Maximum building pressure shall not exceed 0.03 inches of pressure.
- C. Except as specifically indicated in this Specification, Pitot tube traverses shall be made of each duct to measure airflow. Pitot tubes, associated instruments, traverses, and techniques shall conform to ASHRAE Handbook, HVAC Applications, and ASHRAE Handbook, HVAC Systems and Equipment.
 - 1. Use state-of-the-art instrumentation approved by TAB specialists governing agency.
 - 2. Where ducts' design velocity and air quantity are both less than 1000 fpm/CFM, air quantity may be determined by measurements at terminals served.
- D. Test holes shall be placed in straight duct, as far as possible downstream from elbow, bends, take-offs, and other turbulence-generating devices.
- E. For variable-air-volume systems, develop a plan to simulate diversity.
- F. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- G. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with properly sized thermal protection.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check condensate drains for proper connections and functioning.
- M. Check for proper sealing of air-handling-unit components.
- N. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."
- O. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.
- P. Automatically operated dampers shall be adjusted to operate as indicated in Contract Documents. Controls shall be checked for proper calibration.

3.05 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 total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Alternative methods shall be examined for determining total CFM, i.e., Pitot-tube traversing of branch ducts, coil or filter velocity profiles, prior to utilizing airflow values at terminal outlets and inlets.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

- b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the 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.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - a. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - b. 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 mode to determine the maximum required brake horsepower.
- B. Check operation of relief air dampers. Measure total relief air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust relief air dampers to provide 100 percent relief in economizer mode. Ensure that relief dampers close completely upon unit shutdown.
 - C. Check operation of outside air dampers. Measure total outside air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust outside air dampers to provide 100 percent outside air in economizer mode. Ensure that outside air dampers close completely upon unit shutdown.
 - D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - 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. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - E. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading digital backflow compensating hood. Use outlet manufacturer's written instructions and calculating factors only when direct-reading hood cannot be used due to physical obstruction or other limiting factors. Final report shall indicate where values listed have not been obtained by direct measurement.

- F. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch 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, if included.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts. Terminal air velocity at five feet above finished floor shall not exceed 50 feet per minute in occupied air conditioned spaces.
- G. Do not overpressurize ducts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Comply with applicable requirements for constant-volume air systems in addition to those listed below.
- B. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 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 the 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 airflow.
 - 4. 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 the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. 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.
8. Record final fan-performance data including optimum operating static control set point.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Complete air balance prior to hydronic systems balancing.
- B. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed ranges given in article, Tolerances.
- C. Prepare schematic diagrams of systems' "as-built" piping layouts.
- D. 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 liquid level in expansion tank.
 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. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.08 PROCEDURES FOR CONSTANT-FLOW 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.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Section 232123 "Hydronic Pumps."
 2. Check system resistance. 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.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 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 ranges given in article, Tolerances.
- B. Venturies and calibrated orifices with portable or permanent flow meters shall be used to balance the water flows. When such components have not been installed, measure temperature differential across coils or other elements and balance accordingly.
- C. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- D. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- E. Set calibrated balancing valves, if installed, at calculated presettings.
- F. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- G. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- H. 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.
- I. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- J. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- K. Check settings and operation of each safety valve. Record settings.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

1.2 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

1.3 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. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter manufacturer's name, model number, size, type, and thermal-protection-element rating.
 - a. Starter strip heater size, type, and rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

1.4 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

1.5 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

1.6 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

- A. Measure pressure drop across each backflow preventer assembly at design flows.
- B. 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.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect Owner Construction Manager Commissioning Authority and comply with requirements in Section 221123 "Domestic Water Pumps."
 2. Check system resistance. 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.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 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 range given in article, Tolerances.
- C. Set calibrated balancing valves, if installed, at calculated presettings.
- D. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- E. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- F. 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.
- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- I. Check settings and operation of each safety valve. Record settings.

1.7 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent and minus 0 percent.
 2. Air Outlets and Inlets: Plus 5 percent and minus 5 percent.
 3. Multiple outlets within single room: Plus 5 percent and minus 0 percent for total airflow within room. Tolerance for individual outlets within a single room having multiple outlets shall be as for "Air Outlets and Inlets".
 - a. Room shall be balanced to create pressure relationship (positive, negative, or neutral) with adjacent spaces as indicated on Drawings. Maintain airflow differentials between supply, return, and exhaust indicated on Drawings.
 4. Heating-Water Flow Rate: Plus or minus 10 percent.
 5. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Set plumbing systems water flow rates within plus or minus 10 percent.

1.8 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. Interim Reports: Prepare periodic lists of conditions requiring correction 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.

1.9 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 field supervisor. Report shall be co-signed by the Contractor, attesting that he has reviewed the report, and the report has been found to be complete and accurate.
 - 2. The certification sheet shall be followed by sheet(s) listing items for which balancing objectives could not be achieved. Provide explanation for failure to achieve balancing objectives for each item listed.
 - 3. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. 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. Project Performance Guaranty
 - 6. Architect's name and address.
 - 7. Engineer's name and address.
 - 8. Contractor's name and address.
 - 9. Report date.
 - 10. Signature of TAB supervisor 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.
 - 13. Nomenclature sheets for each item of equipment.

14. Data for terminal units, including manufacturer's name, type, size, and fittings.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. 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 outdoor, supply, return, and exhaust airflows.
 2. Water and steam 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.
- E. Air distribution outlets and inlets shall be shown on keyed plans with designation for each outlet and inlet matching designation used in Contract Documents and TAB test reports. Room numbers shall be included in keyed plans and test reports. Where multiple outlets and inlets are installed within a single room, a designation shall be assigned and listed for each outlet and inlet in addition to room number.
- F. Test Reports – General:
 1. All test reports containing air or liquid flow data shall record flow values prior to system adjustment in addition to required data listed for each test report.
- G. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 1. Unit Data:
 - 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. Center-to-center dimensions of sheave, and amount of adjustments in inches.

- j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. VFD model and number.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Relief airflow in cfm.
 - l. Outdoor-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
 - m. Return-air damper position.
 - n. Relief-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
 - o. Vortex damper position.
- H. Apparatus-Coil Test Reports:
1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.

- h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-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.
 - m. Inlet steam pressure in psig.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. 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. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 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.
- J. 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 air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
- 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.

- L. System-Coil Reports: For reheat coils and water coils of terminal units, 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):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. 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 rpm.
 - 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.
- N. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

1.10 INSPECTIONS

- A. Initial Inspection:
- 1. After testing and balancing are complete, 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.
 - 2. Check the following for each system:
 - 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 sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
- 1. After initial inspection is complete and documentation 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 Architect.
 - 2. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.
 - 3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than 10 percent, 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.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. 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.
 2. If the second final inspection also fails, Owner may contact the TAB specialists' governing organization for remedial action by the governing organization under the workmanship and performance warranty. See article, Warranty.
 3. If remedial action is not provided by the TAB specialists' governing organization in a timely manner, Owner may contract the services of another TAB specialist to complete the TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB specialists' final payment.
- D. Prepare test and inspection reports.

1.11 ADDITIONAL TESTS

- A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply.
- B. Related Sections:
 - 1. Section 23 07 16 "HVAC Equipment Insulation."
 - 2. Section 23 07 19 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.02 ACTION 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).
- B. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.
- C. Product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.03 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.

1.04 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 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.

1.06 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.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.

- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- G. 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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

2.02 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. VOC Content: 300 g/L or less.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 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

2.04 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.
 - 2. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
 - 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 5. Service Temperature Range: 0 to plus 180 deg F.
 - 6. Color: White.

2.05 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
 - 6. Sealant shall have a VOC content of 420 g/L or less.
 - 7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2.06 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 C 1136, Type II.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.08 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Alpha Associates, Inc.

1.1 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
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.

1.2 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, [1/2 inch] [3/4 inch] wide with [wing seal] [or] [closed seal].
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Hardcast, Inc.
 - 4) Midwest Fasteners, Inc.
 - 5) Nelson Stud Welding.

2. 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.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) AGM Industries, Inc.
 - 2) CL WARD & Family Inc.
 - 3) Gemco.
 - 4) Hardcast, Inc.
 - 5) Midwest Fasteners, Inc.
 - 6) Nelson Stud Welding.
3. 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.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Hardcast, Inc.
 - 4) Midwest Fasteners, Inc.
 - 5) Nelson Stud Welding.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 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 the following, or equal:
 - a. C & F Wire.

1.3 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 2 - EXECUTION

2.01 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.

2.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

2.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to 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 duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.

2.04 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.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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 078400 "Firestopping" and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Firestopping."

2.05 INSTALLATION OF MINERAL-FIBER INSULATION

- A. 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 sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. 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 temperatures 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 one edge and one 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 at 18-foot 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 two times the insulation thickness, but not less than 3 inches.
 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.
- B. 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 transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - 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 temperatures 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 one edge and one 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 at 18-foot 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 two times the insulation thickness, but not less than 3 inches.
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 stiffener, hanger, and flange with pins spaced 6 inches o.c.

2.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. 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 defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

2.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply air.
- B. Items Not Insulated:
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.

2.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick, R-4.2.
- B. Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick, R-4.2.
 2. Mineral-Fiber Board: 1-1/2 inches thick, R-4.2

END OF SECTION

SECTION 23 07 16
HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
 - 1. Chilled-water pumps.
 - 2. Heating, hot-water pumps.
 - 3. Expansion tanks.
 - 4. Air separators.
- B. Related Sections:
 - 1. Section 23 07 13 "Duct Insulation."
 - 2. Section 23 07 19 "HVAC Piping Insulation."

1.02 ACTION 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).
- B. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.
- C. Product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Product Data: For coatings, indicating VOC content.
 - 3. Product Data: For sealants, indicating VOC content.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail removable insulation at equipment connections.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.
 - 5. Detail field application for each equipment type.

1.03 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.

1.04 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 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.

1.06 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 equipment Installer for equipment insulation application.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied FSK. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.

2.03 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 - 4. 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."
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 - 4. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. VOC Content: 300 g/L or less.
 - 2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Knauf Insulation.
 - c. Vimasco Corporation.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, 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. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Knauf Insulation.
 - e. Mon-Eco Industries, Inc.
 - f. Vimasco Corporation.
 - 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.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

2. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
5. Service Temperature Range: 0 to plus 180 deg F.
6. Color: White.

2.06 SEALANTS

A. Joint Sealants:

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. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - e. Pittsburgh Corning Corporation.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

B. FSK and Metal Jacket Flashing Sealants:

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. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.07 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 C 1136, Type II.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.09 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Alpha Associates, Inc.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - c. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. 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.

2.11 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 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.

2.12 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) AGM Industries, Inc.
 - 2) Gemco.

- 3) Midwest Fasteners, Inc.
 - 4) Nelson Stud Welding.
2. 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.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - 4) Nelson Stud Welding.
3. 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.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - 4) Nelson Stud Welding.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 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 the following, or equal:
 - a. C & F Wire.

2.13 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.01 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 and equipment 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.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.
- O. 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. Manholes.
 5. Handholes.
 6. Cleanouts.

3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-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 adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches 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 from each end. Install wire or cable between two circumferential girdles 12 inches 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 o.c. Use this network for securing insulation with tie wire or bands.
- 7. Stagger joints between insulation layers at least 3 inches.
- 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.
- B. Insulation Installation on Pumps:
 - 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - 2. Fabricate boxes from stainless steel, at least 0.060 inch thick.
 - 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.05 FIELD-APPLIED JACKET INSTALLATION

- A. 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.

3.06 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections: 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 defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

1.1 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Chilled-water pump insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- D. Heating-hot-water pump insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- E. Heating-hot-water expansion/compression tank insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Pipe and Tank: 1-1/2 inch thick.
- F. Chilled-water air-separator insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Pipe and Tank: 1-1/2 inch thick.
- G. Heating hot-water air-separator insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inch thick and 3-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Pipe and Tank: 2 inch thick.

1.2 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. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.040 inch thick.

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping, indoors and outdoors.
 - 2. Chilled-water and brine piping, outdoors.
 - 3. Heating hot-water piping, indoors and outdoors.
 - 4. Refrigerant suction, liquid and hot-gas piping, indoors and outdoors.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."
 - 2. Section 230716 "HVAC Equipment Insulation."

1.02 ACTION 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).
- B. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.
- C. Product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Product Data: For coatings, indicating VOC content.
 - 3. Product Data: For sealants, indicating VOC content.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.

1.03 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.

1.04 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, 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 agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 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.

1.06 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 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.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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.

PART 2 - PRODUCTS

2.01 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 shall be applied.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ramco Insulation, Inc.

2.03 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.

- c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
- 2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. VOC Content: 300 g/L or less.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation.
 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.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Adhesives shall have a VOC content of 50 g/L or less.
 2. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.

4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
5. Service Temperature Range: 0 to plus 180 deg F.
6. Color: White.

2.06 SEALANTS

A. Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

B. ASJ Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2.07 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 C 1136, Type I.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.09 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Alpha Associates, Inc.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - d. Speedline Corporation.

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.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - c. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B 209, 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: 2.5-mil- thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-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.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.

- c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 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. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc.; an American Biltrite company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 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.

2.12 SECUREMENTS

- A. Bands:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 - 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 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 the following, or equal:
 - a. C & F Wire.

PART 3 - EXECUTION

3.01 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.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 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 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, 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. 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 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to 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 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. 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. Manholes.
 5. Handholes.
 6. Cleanouts.

3.04 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: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078400 " Firestopping" for firestopping and fire-resistive joint sealers.
- E. 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 078400 "Firestopping."

3.05 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.
- B. 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. 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 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 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 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.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- 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 shall conform 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 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 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.

3.06 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 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 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 preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed 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.

3.07 INSTALLATION OF MINERAL-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 o.c.
4. For insulation with factory-applied 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 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 mineral-fiber 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 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.

3.08 FIELD-APPLIED JACKET INSTALLATION

- A. 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.

3.09 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. 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 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.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Chilled Water and Brine, above 40 Deg F:
 - 1. All Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
- C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.
- D. Refrigerant Suction, Liquid, and Hot-Gas Piping:
 1. NPS 3/4 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
 2. NPS 1 and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1-1/2 inches thick.
- E. Refrigerant Suction, Liquid, and Hot-Gas Flexible Tubing:
 1. NPS 3/4 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
 2. NPS 1 and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1-1/2 inches thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- C. Refrigerant Suction, Liquid, and Hot-Gas Piping:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.
- D. Refrigerant Suction, Liquid, and Hot-Gas Flexible Tubing:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.
- E. Insulation for cased underground piping systems is specified in Section 232113.13 "Underground Hydronic Piping."

3.14 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.
- D. Piping, Exposed:
 1. PVC: 30 mils thick.

3.15 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, Exposed:
 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.040 inch thick.

3.16 PIPE PROTECTION

- A. Field-installed insulation jacket may be omitted for manufactured, pre-charged and pre-insulated refrigerant line-set piping run in rigid or flexible conduit.
- B. Field-installed insulation jacket may be omitted for field-assembled refrigerant piping run in rigid or flexible conduit.
- C. Refer to Article, Piping Installation, in Section 232300 "Refrigerant Piping," for refrigerant pipe protection requirements.

END OF SECTION

SECTION 23 09 23
DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish a campus standard Alerton Compass System. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ ASHRAE Standard 135-2016, BACnet. All workstations and controllers, including unitary controllers, shall be native BACnet MSTP or BACnet IP devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- B. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- D. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
- M. Include as an added bid item the cost of the service contract for the remote monitoring of all BMS controlled systems in the building.
- N. Include as an added bid item the cost of the scheduling modifications and refinement with the tenant.

1.02 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASH RAE Standard 135-2016, BACnet and achieved listing under the BACnet Testing Laboratories BACnet - Advanced Workstation Software (B-AWS). This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, AC units, etc., and all air handlers, boilers, lighting control panels, UPS, generators, building elevators, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. Provide integration to the lighting system through BACnet IP protocol so the lighting can be scheduled through the DOC system and include graphics that show whether lights are on or off on the floor plans. The DOC system shall be able to interface with the lighting control panel to facilitate scheduling, automatic daylight saving time adjustments, etc.
- C. Operator's workstation software shall use Microsoft Windows 8 or Windows 10 as the computer operating system. The Direct Digital Control system (DOC) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, and a full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system, along with scheduling and trending applications, will be left with the owner. All software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools, including graphical programming and applications will be left with the owner.
- D. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- E. Room sensors shall be provided with digital readout that allows the user to view room temperature and humidity, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow a technician to balance VAV zones and access any parameter in zone controller directly from the room sensor. Field service mode shall have the ability to be locked out.
- F. All application controllers for every terminal unit (VAV, FCU, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet MSTP.

1.03 APPROVED MANUFACTURERS

- A. Approved Control Manufacturers
 - 1. Alerton Compass (integrated into existing Alerton Compass network)
 - 2. Other systems will not be accepted.

1.04 QUALITY ASSURANCE

- A. The Building Automation System (BAS) system shall be designed, installed, commissioned, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 2 hours' response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.
- B. The contractor shall provide full-time, on-site, experienced project manager for this work, responsible for direct supervision of the design, installation, start-up and commissioning of the BAS system.
- C. The Bidder shall be regularly engaged in the design, installation and maintenance of BAS systems and shall have demonstrated technical expertise and experience in the design, installation and maintenance of BAS systems similar in size and complexity to this project.
- D. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
- E. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- F. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- G. Control system shall be engineered, programmed and supported completely by representative's local office

1.05 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2016, BACnet.
 - 3. California Building Code (CBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A
 - 7. EMC Directive 89/336/EEC (European CE Mark).
 - 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.
- B. City, county, state, and federal regulations and codes in effect as of contract date.

- C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

1.06 SUBMITTALS

- A. Drawings
 - 1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
 - 2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
 - 3. Eight complete sets (copies) of submittal drawings shall be provided.
 - 4. Drawings shall be available on CD-ROM.
- B. System Documentation: Include the following in submittal package:
 - 1. System configuration diagrams in simplified block format.
 - 2. All input/output object listings and an alarm point summary listing.
 - 3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - 4. Complete bill of materials, valve schedule and damper schedule.
 - 5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 - 6. Overall system operation and maintenance instructions- including preventive maintenance and troubleshooting instructions.
 - 7. For all system elements-operator's workstation(s), building controller(s), application controllers, routers, and repeaters- provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ ASHRAE Standard 135-2016.
 - 8. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
 - 9. A list of all functions available and a sample of function block programming that shall be part of delivered system.
- C. Project Management
 - 1. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents, and shall indicate timing and dates for system installation, debugging, and commissioning.

1.07 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday and 48 hours on Saturday and Sunday.
- C. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.01 OPERATOR'S WORKSTATION

- A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 simultaneous clients.
- B. BACnet Conformance
 - 1. Operator Work Station shall be approved by the BTL as meeting the BACnet Advanced Work Station requirements.
 - 2. Refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog *Value*, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 4. The operator's workstation shall comply with Annex J of the BACnet specification for IP connections. Must support remote connection to server using a thick client application. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.
- C. Displays
 - 1. Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.

2. All displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory development of graphics or programming of DOC logic are specifically prohibited.
3. Binary objects shall be displayed as ACTIVE/I NACTIVE/NULL or with customized text such as Hand-Off-Auto. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse, for example, a graphic of a switch or light, which then displays a different graphic (such as an "ON" switch or lighted lamp. Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time- based animation. The operator shall be able to click an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.
4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the "increase" or "decrease" arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trend logs.
5. Analog objects may also be assigned to a system graphic, where the color of the defined object changes based on the analog object's value. For example, graphical thermostat device served by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. All editing and area assignment shall be created or modified online using simple icon tools.
6. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label pushbuttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display

and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

7. The BAS displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a Web browser resolving to a specified Web address.
8. The BAS system shall have the ability to run multiple, concurrent displays windows showing continuously updated data.
9. Graphic items with custom geometry that offer both color gradient shading and variable opacity in scale to system variables and range setpoints (OmniGraphics). Ability to automatically resize to display (OmniZoom).

D. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. Each operator's terminal shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well restricted access to discrete BACnet devices to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Users should have the capability to be assigned to specific user type "groups" that can share the same access levels to speed setup. Users who are members of multiple "groups" shall have the ability to activate/deactivate membership to those groups while using the BAS (without logout). Users shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.
3. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
4. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log

1. Operator Activity Log that tracks all operator changes and activities shall be included with system. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.
2. Log shall be gathered and archived to hard drive on operator's workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.

3. Any displayed data that is changeable by the operator may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

F. Scheduling

1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule or launch the Schedule Wizard to allow the point to be scheduled.

G. Alarm Indication and Handling.

1. Operator's workstation shall provide audible, visual, printed, and email means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s) currently running. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).

4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
5. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or launch the Alarm Wizard to allow the creation of a new alarm.

H. Trendlog Information

1. System server shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the operator's workstation. Operator shall be able to view all trended records, both stored and archived. All trendlog records shall be displayed in standard engineering units.
2. Software that is capable of graphing the trend logged object data shall be included. Software shall be capable of creating two-axis (X, Y) graphs that display up to 10 object types at the same time in different colors. Graphs shall show object values relative to time. Each trendlog shall support a custom scale setting for the graph view that is to be stored continuously. System shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. Operator shall be able to change Trendlog setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.
4. System shall include a Trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right-clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.
5. System shall be capable of using Microsoft SQL as the system database.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trendlog shall then be selectable on the screen. Selection of the trendlog using this method shall allow the viewing of the trendlog view or launch the Trendlog wizard to allow the creation of a new trend.

I. Energy Log Information

1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.

2. All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

J. Demand Limiting

1. System shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Binary shedding shall include minimum of five (5) priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one, the loads shall be shed/restored in a "first off-first on" mode, and in the other the loads are just shed/restored in a "first off-last on" (linear) fashion.
3. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.
4. Status of each and every load shed program shall be capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

K. Tenant Activity

1. System shall include program that monitors after-hours overrides by tenants, logs that data, and generates a bill based on usage and rate charged for each tenant space. Tenant Activity program shall be able to assign multiple zones, from a list of every zone connected to system, to a particular tenant. Every zone is monitored for after-hour override usage and that data logged in server. Operator may then generate a bill based on the usage for each tenant and the rate charged for any overtime use.
2. Configuration shall include entry of the following information for use in logging and billing:
 - a. Tenant's contact name and address
 - b. One or multiple tenant zones that make up a total tenant space, including a separate billing rate for each separate zone
 - c. Minimum and maximum values an event duration and event limit
 - d. Property management information
 - e. Overall billing rate
 - f. Seasonal adjustments or surcharge to billing rate

- g. Billing notification type such including, but not limited to printer, file and email
 - h. Billing form template
 - 3. Logging shall include recording the following information for each and every tenant event:
 - a. Zone description
 - b. Time the event begins
 - c. Total override time
 - d. Limits shall be applied to override time
 - 4. A tenant bill shall be generated for a specific period using all the entered configuration data and the logged data. User with appropriate security level shall be able to view and override billing information. User shall be able to select a billing period to view and be able to delete events from billing and edit a selected tenant activity event's override time.
- L. Reports
 - 1. System server shall be capable of periodically producing reports of trendlogs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.
 - 2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.
- M. Configuration/Setup
 - 1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.
- N. Field Engineering Tools
 - 1. Operator's workstation software shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
 - 2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
 - 3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format
 - 4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to

select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
6. System shall automatically notify the user when a device that is not in the database is added to the network.
7. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
8. The system shall provide a means to scan, detect, interrogate, and edit third-party BACnet devices and BACnet objects within those devices.

O. Workstation Hardware

1. Provide operator's workstation(s) at location(s) noted on the plans.
2. Workstation/server computer minimum requirements
 - a. PC Processor of 2.5 GHz quad-core or better
 - b. 8 GB RAM or better
 - c. 1TB hard disk or better
 - d. High-performance graphics adapter
 - e. Ethernet 10/100 network interface card
 - f. Keyboard, monitor, mouse, USB port and CD-ROM
 - g. Microsoft Windows 8 or Windows 10
 - h. Monitor size shall be 22" minimum
 - i. Color printer (inkjet, color dye or laser)

P. Software

1. At the conclusion of project, contractor shall leave with owner a CD ROM that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner how to completely restore the system in the case of a computer malfunction.

2.02 GRAPHICAL USER INTERFACE

A. Display of Data

1. Graphics displays shall include animation of all Fans shall turn, pilot lights shall blink, coils shall change colors, and so on.
2. Real-time data shall be shown. This data must be directly gathered using the BACnet network and automatically updated without any user action.

3. It shall be possible for user to change data if the user is logged on with the appropriate password. Clicking on a button or typing in a new value shall change digital data. Using pull-down menus or typing in a new value shall change analog data.
 4. Data displays shall be navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display.
- B. Time Schedule Adjustment
1. Logged in access shall allow user to view and edit all schedules in the system. This includes standard, holiday and event schedules as described in BAS specification. Display of schedules shall show interaction of all schedules on a single display so user sees an overview of how all work together. User shall be able to edit schedules from this display.
 2. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.
 3. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.
- C. Logging of Information
1. User shall use standard browser technology to view all trendlogs in system. User shall be able to view logged data in tabular form or graphical format. User shall be able to adjust time interval of logged data viewed and shall be able to adjust Y axis of data viewed in graphical format. Data shall be in CSV format.
- D. Alarm Handling
1. The front end shall display alarms as they occur. User shall be able to acknowledge alarms using browser technology. In addition, user shall be able to view history of alarm occurrence over a user-selected time frame. In addition, those alarms may be filtered for viewing per user-selected options. A single selection shall display all alarms that have not been acknowledged.
- E. BACnet Communication
1. The Alerton system shall directly communicate to all devices on the BAS network using BACnet protocol. No intermediate devices shall be necessary for BACnet communication.

2.03 BUILDING CONTROLLER

A. General Requirements

1. BACnet Conformance
 - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
 - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the

functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2. Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers-including central plant controllers, advanced application controllers and unitary controllers-supplied by BAS manufacturer shall utilize the BACnet protocol standard.
3. Modules shall be selected to fit the particular project application. Up to seven modules shall be powered by a single power supply module. All modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. A module in the middle shall be replaceable without removing any other modules.
4. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
5. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
6. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
7. Controller shall have sufficient memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.
8. Global control algorithms and automated control functions shall execute using 32-bit processor.
9. Schedules
 - a. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
 - b. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
10. Logging Capabilities

- a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - b. Logs may be viewed both on-site or off-site using WAN or remote communication.
 - c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
 - d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
11. Alarm Generation
- a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - b. Each alarm may be dialed out as noted elsewhere.
 - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
 - d. Controller must be able to handle up to 320 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
12. Demand Limiting
- a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.
 - b. Load shedding programs in building controller modules shall operate as defined in section 2.1.J of this specification.
13. Tenant Activity Logging
- a. Tenant Activity logging shall be supported by building controller module. Each independent module shall support a minimum of 80 zones.
 - b. Tenant Activity logging shall function as defined in section 2.1.K of this specification.
- B. Ethernet - MS/TP Module
- 1. Ethernet - MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
 - 2. All communication with operator's workstation and all application controllers shall be through BACnet. Building controller Ethernet - MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100 MHz) and MS/TP LAN. Ethernet - MS/TP module shall also route messages from all other building controller modules onto the BACnet Ethernet network.
 - a. MS/TP LAN must be software-configurable from 9.6 to 76.8Kbps.
 - b. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
 - 3. BACnet Conformance
 - a. Ethernet - MS/TP module shall, as a minimum, support MS/TP and Ethernet BACnet LAN types. It shall communicate directly using these BACnet LANs as a native BACnet

device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be approved by the BACnet Testing Laboratory (BTL) as meeting the BACnet Building Controller requirements.

- b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- c. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-I P communications to other BACnet devices on the LAN. Must support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).

C. MS/TP Module

- 1. MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following:
 - a. Building controller MS/TP module communications shall be through BACnet MS/TP LAN to all advanced application and application-specific controllers. MS/TP module shall also route messages to Ethernet - MS/TP module for communication over WAN.
 - b. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps
 - c. Configuration shall be through RS-232 connection.
- 2. BACnet Conformance
 - a. MS/TP module shall be approved by the BTL (BACnet Testing Laboratory) as meeting the BACnet Building Controller requirements. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly using this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between all supported LAN types.
 - b. Standard BACnet object types supported shall include, as a minimum, Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Power Supply Module

- 1. Power supply module shall power up to seven building controller modules. Input for power shall accept between 17-30VAC, 47-65Hz.
- 2. Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of all data in flash memory and for continuous operation of real-time clocks for minimum of 20 days.

2.04 AIR HANDLER APPLICATION CONTROLLERS

- A. Provide one or more native BACnet application controllers for each air handler and provide native BACnet application controllers as needed for central plant control that adequately cover all objects listed in object list. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers

shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.

A. BACnet Conformance

1. Application controllers shall be approved by the BTL as meeting the BACnet Advanced Application Controller requirements.
2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

B. Application controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0-10VDC, Platinum 1000 ohm RTD, 0-SVDC, 4-20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs with 12-bit resolution shall support either 0-10VDC or 0-20mA. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs.

1. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.
2. All outputs must have onboard Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
3. The position of each and every HOA switch shall be available system wide as a BACnet object property.

C. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.

1. The following control blocks shall be supported:
 - a. Natural Log
 - b. Exponential
 - c. Log base 10

- d. X to the power of Y
 - e. Nth square root of X
 - f. f. 5th Order Polynomial Equations
 - g. Astronomical Clock (sunrise/sunset calculation)
 - h. Time based schedules
- D. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.
- E. Application controller shall include support for intelligent room sensor (see Section 2.10.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- F. Schedules
1. The controller shall support a minimum of 3 BACnet Schedule Objects and have a real time clock on board with battery backup to maintain time through a power loss.
- G. Logging Capabilities
1. Controller shall support a minimum of 50 trendlogs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 2. Controller shall periodically upload trended data to system server for long-term archiving if desired. Archived data stored in (MS Jet Database or SQL) database form and shall be available for use in third-party spreadsheet or database programs.
- H. Alarm Generation
1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.
 2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
 3. Controller must be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
- I. The controller processor shall be a 32-bit processor.
- J. The packaging of the controller shall provide operable doors to cover the terminals once installation is complete. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

2.05 TERMINAL UNIT APPLICATION CONTROLLERS (FAN-COILS)

- A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall

be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance

1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and IOK thermistors, 0-5VDC, 4-20mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.10.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.06 VAV BOX CONTROLLERS- SINGLE DUCT WITH HOT WATER REHEAT

- A. Provide one native BACnet application controller for each VAV box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board

CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.

B. BACnet Conformance

1. Application controllers shall, at a minimum, support MS/TP BACnet LAN types. They shall communicate directly through this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, 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 IOK 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).

D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PIO loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator's workstation section. All programming tools shall be provided as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.10.B.) Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operations for specific display requirements for intelligent room sensor.

F. 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 non-volatile memory. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through

intelligent room sensor. Operator's workstation, portable computers, and special hand-held field tools shall not be needed for field calibration.

- G. Provide duct temperature sensor at discharge of each VAV box that is connected to controller for reporting back to operator's workstation.

2.07 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

- B. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

C. Intelligent Room Sensor with LCD Readout

1. All room sensors shall be a combination temperature and humidity sensor and integrated Co2 where shown on the floor plans. The 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.
2. Override time may be set and viewed in half-hour increments. Override time countdown 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.
3. 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.
4. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV 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.

D. Wall Sensor

1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port.

E. Wireless Wall Sensor

1. Wireless wall sensor shall use solid-state sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler dial for set

point adjustment. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port. There shall be a mechanical means to lock the wall sensor to the base to prevent theft and vandalism.

2. Wireless wall sensor shall have a battery life of 5 year with alkaline batteries and 7.5 years with lithium batteries. A low battery indication shall be signaled to the controller prior to the battery being exhausted. The wireless sensor shall run on industry standard AA style batteries.
3. The wireless range in open air shall meet or exceed 300 ft. The strength of the wireless signal must be indicated at the wireless sensor to aid in placement and trouble shooting. The receiver shall have a wireless-communications-received light that indicates the proper communication is occurring.
4. The wireless wall sensor and receiver must be paired in an addressable mean to facilitate easy replacement and reassignment.

F. Airflow Control:

1. Where indicated, provide airflow measuring stations and control. Refer to Section 237213, "Custom Air Handling Units," and control diagrams on Drawings.
2. A factory-furnished and calibrated controller shall be programmed, in nonvolatile EPROM, with application-specific airflow set point and range.
3. The controller and actuator shall communicate to control the desired airflow.
4. The controller shall receive a zero- to 10-V de input signal and report a zero- to 20- mA output signal that is proportional to the airflow.
5. Airflow measurement and control range shall be suitable for operation between 150 to 2000 fpm (0.8 to 10 m/s).
6. Ambient Operating Temperature Range: Minus 40 to plus 140 deg F (Minus 40 to plus 60 deg C).
7. Ambient Operating Humidity Range: 5 to 95 percent relative humidity, non- condensing.
8. Provide unit with control transformer rated for not less than 85 VA. Provide transformer with primary and secondary protection and primary disconnecting means. Coordinate requirements with field power connection.
9. Provide screw terminals for interface to field wiring.
10. Factory mount electronics within a NEMA 250, Type 1painted steel enclosure.

2.08 THERMAL ENERGY METERS

- A. Performance Requirements: Manufacturer shall certify that each energy meter indicated complies with specified performance requirements and characteristics.
1. Product certificates are required.
 2. Insertion-Type Thermal Energy Meters:
 - a. Manufacturer: Subject to compliance with requirements, provide products by the following:

- 1) ONICON Incorporated Turbine Flow Meter Model F-1210 and BTU Meter Model System-10-BAC.
- b. Description:
- 1) Factory-packaged meter consisting of supply and return temperature sensors, flow sensor, digital display, keypad user interface, installation hardware, color-coded interconnecting cabling, and installation instructions.
 - 2) Each thermal energy meter shall be individually calibrated and provided with calibration certification traceable to NIST.
- c. Alphanumeric display of the following on face of enclosure:
- 1) Total energy consumption.
 - 2) Energy rate.
 - 3) Flow rate.
 - 4) Supply temperature.
 - 5) Return temperature.
 - 6) Visual indication of power status (on/off) on face of enclosure.
- d. Electronics Enclosure:
- 1) Remote from temperature and flow sensors.
 - 2) NEMA 250, Type 12 or Type 13 for indoor applications and NEMA 250, Type 4 or Type 4X for outdoor applications.
 - 3) Labeled terminal strip for field wiring connections.
- e. Programming:
- 1) Factory programmed for specific application and field programmable through keypad on face of enclosure.
 - 2) Programmed parameters and total energy consumption shall be stored in non-volatile EEPROM memory.
- f. Output Signals:
- 1) Total Energy Consumption: Isolated solid-state dry contact with 100 mA, 50-V rating and contact duration of 0.5, 1, 2, or 6 seconds.
 - 2) Energy Rate, Flow Rate, Supply Temperature, Return Temperature: 4 to 20 mA or zero- to 10-V de for each.
- g. Temperature Sensors:
- 1) Temperature range matched to application.
 - 2) Temperature accuracy within 0.15 deg F (0.08 deg C) over the calibrated range.
 - 3) Stainless-steel or brass thermowell with NPS 1/2 (DN 15) N PT connection for each sensor.
- h. Current Sensors:

- 1) Veris Model H-908 or equal.
- i. Differential Pressure Transmitters & Switches:
 - 1) Duct Static Pressure shall be Dwyer Model MS2-D102 or equal.
 - 2) Space Static Pressure shall be Dwyer Model MS2-WIII or equal.
 - 3) Hydronic Differential Pressure shall be Dwyer Model 629-05-CH-P2-E5- 51-3V or equal.
 - 4) Filter Switches shall be Dwyer Model ADPS-04-1-N or equal.

2.09 ELECTRONIC ACTUATORS AND VALVES

- A. Quality Assurance for Actuators and Valves
 1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
 2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
 3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
- B. Execution Details for Actuators and Valves
 1. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
 2. Each DOC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DOC as an analog input for true actuator position status.
 3. VAV box damper actuation shall be floating type or analog (2-IOVDC, 4-20mA).
 4. Booster-heat valve actuation shall be floating type or analog (2-IOvdc, 4-20ma).
 5. Primary valve control shall be analog (2-IOVDC, 4-20mA).
- C. Actuators for damper and control valves 0.5-6 inches shall be electric unless otherwise specified, provide actuators as follows:
 1. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify actuators.
 2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.
 3. Five-year manufacturer's warranty. Two-year unconditional and Three year product defect from date of installation.
 4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
 5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
 6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall

insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.

7. A Pushbutton gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24VAC and consume IOVA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside air and exhaust air damper actuators shall be mechanical spring return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer actuators shall utilize analog control 2-IOVDC, floating control is not acceptable.
3. Electric damper actuators (including VAV box actuators) shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)

E. Valve Actuators 0.5-6 inches

1. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail-safe flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
2. All zone service actuators shall be non-spring return unless otherwise specified.
3. The valve actuator shall be capable of providing the minimum torque required for proper valve close-off for the required application.
4. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
5. Override handle and gearbox release shall be provided for all non-spring return valve actuators.

F. Control Valves 0.5-6 inches

1. The BAS contractor shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The contractor shall install all valves. Equal percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves that are 2.5 inches and above.
2. Characterized control valves shall be used for hydronic heating or cooling applications and small to medium AHU water-coil applications to 200 GPM. Cooling tower coil control

valves shall be for water-coil applications up to 550 GPM Actuators are non-spring return for terminal unit coil control unless otherwise noted. If the coil is exposed to the outside air stream, see plans for spring return requirement.

- a. Leakage is aero percent, close-off is 200psi, maximum differential is 30psi; rangeability is 500:1.
 - b. Valves 0.5-2 inches shall be nickel-plated forged brass body, NPT screw type connections.
 - c. Valves 0.5-1.25 inches shall be rated for ANSI Class 600 working pressure. Valves over 1.5 inches shall be rated for ANSI Class 400 working pressure. Two- position control valves shall be line size.
 - d. The operating temperature range shall be 0-250 degrees F.
 - e. Stainless steel ball and stem shall be furnished on all modulating valves.
 - f. Seats shall be fiberglass reinforced Teflon.
 - g. Two-way and three-way valves shall have an equal percentage control port. Full stem rotation is required for maximum flow to insure stable BTU control of the coil.
 - h. Three-way valve shall be applicable for both mixing and diverting.
 - i. The characterizing disc is made of TEFZEL and shall be keyed and held secure by a retaining ring.
 - j. The valves shall have a blow-out proof stem design.
 - k. The stem packing shall consist of 2 lubricated O-rings designed for on-off or modulating service and require no maintenance.
 - l. The valves shall have an ISO type, 4-bolt flange for mounting actuator in any orientation parallel or perpendicular to the pipe.
 - m. A non-metallic thermal isolation adapter shall separate valve flange from actuator.
 - n. One fastening screw shall secure the direct coupling of the thermal isolation adapter between the actuator and the valve. This will prevent all lateral or rotational forces from affecting the stem and its packing O-rings.
3. Globe valves 0.5-2 inches shall be single port, top or bottom guided plug control or water flow applications.
- a. Valves shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure.
 - b. Valves 0.5 inches (DN15) through 2 inches (DN50) with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (0.1%).
 - c. The operating temperature range shall be 20-280 degrees F.
 - d. Spring loaded TFE packing shall protect against leakage at the stem.
 - e. Two-way valves shall have an equal percentage control port.
 - f. Three-way valves shall have a linear control and bypass port.
 - g. Mixing and diverting valves must be installed specific to the valve design.
4. Globe Valve 2.5-6 inches
- a. Valves 2.5 inches (DN65) through 6 inches (DN150) shall be iron body, 125 lb. flanged with Class III (0.1%) close-off leakage at 50 psi differential.

- b. Valves with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (0.1%).
- c. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
- d. Mixing and diverting valves must be installed specific to the valve design.

G. Butterfly valves

- 1. Butterfly valves shall be sized for modulating service at 60-70 degree stem rotation. Isolation valves shall be line-size. Design velocity shall be less than 12 feet per second when used with standard EPDM seats.
 - a. Body is cast iron.
 - b. Disc is aluminum bronze standard.
 - c. Seat is EPDM standard.
 - d. Body Pressure is 200 psi, -30-275 degrees F.
 - e. Flange is ANSI 125/250.
 - f. Media Temperature Range is -22-240 degree F.
 - g. Maximum Differential Pressure is 200 psi for 2- to 6- inch size.

H. Butterfly Valve Industrial Actuators

- 1. Actuators shall be approved under Canadian Standards Association or other Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
 - a. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120VAC, 1 ϕ H, 60Hz supply. Two adjustable cam-actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
 - b. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
 - c. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
 - d. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.
 - e. The actuator shall be analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2-IOVDC, 4-20mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.

2. Performance Verification Test
 - a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate that is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
 - b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.
3. Actuator mounting for damper and valve arrangements shall comply with the following:
 - a. Damper actuators: Shall not be installed in the air stream
 - b. A weather shield shall be used if actuators are located outside. For damper actuators, use clear plastic enclosure.
 - c. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.
 - d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
4. Damper mounting arrangements shall comply with the following:
 - a. The contractor shall furnish and install damper channel supports and sheet metal collars.
 - b. No jack shafting of damper sections shall be allowed.
 - c. Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.
5. Valve Sizing for Water Coil
 - a. Modulating control valve body size may be reduced, at most, two pipe sizes from the line size or not less than half the pipe size. The BAS contractor shall size all water coil control valves for the application as follows:
 - 1) Booster-heat valves shall be sized not to exceed 4-9psi differential pressure. Size valve for 50% valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 2) Primary valves shall be sized not to exceed 5-15psi differential pressure. Size valve for 50% valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 3) Butterfly valves shall be sized for modulating service at 60-70 degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.
 - b. Valve mounting arrangements shall comply to the following:
 - 1) Unions shall be provided on all ports of two-way and three-way valves.

- 2) Install three-way equal percentage characterized control valves in a mixing configuration with the "A" port piped to the coil.
- 3) Install 2.5 inches and above, three-way globe valves, as manufactured for mixing or diverting service to the coil.

2.10 CONTROL PANELS

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 0.125 inches thick and appropriately sized to make label easy to read.
- E. Control panels must be assembled by a UL authorized fabricator in accordance with UL508A standards and labeled with separate UL label numbers.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.02 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- A. Provide all miscellaneous devices, hardware, software, interconnections, installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.03 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3 feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.04 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.

- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum-rated cable (without conduit).

3.05 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays
 - 1. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization
 - 1. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trendlog
 - 1. All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm
 - 1. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
- F. Database Save
 - 1. Provide backup database for all standalone application controllers on disk.

3.06 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start up and commission systems. Allow sufficient time for startup and commissioning prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for one year or as specified.

- D. Provide owner's representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.07 AS-BUILT DOCUMENTATION REQUIRED

- A. Complete set of accurate control drawings and programming.

3.08 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not be limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of three persons.
- C. Provide on-site training above as required, up to 16 hours as part of this contract.
- D. Provide tuition for at least two individuals to attend for a two-day factory training class.
- E. If applicable, costs for travel, lodging and meals will be the responsibility of the owner.

3.09 DEMONSTRATION

- A. Demonstrate complete operating system to owner's representative.
- B. Provide certificate stating that control system has been tested and adjusted for proper operation.

END OF SECTION

SECTION 22 11 23
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Manual gas shutoff valves.
 - 5. Earthquake valves.
 - 6. Pressure regulators.
 - 7. Dielectric fittings.

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 3. Pressure regulators. Indicate pressure ratings and capacities.
 - 4. Dielectric fittings.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
 - 1. Shop Drawing Scale: 1/4 inch per foot.
 - 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.
- E. Gas Pipe Installer Qualifications: Provide evidence of current qualifications for individuals performing work requiring qualifications.
- F. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators and earthquake valves, to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. 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.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.08 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner and Construction Manager no fewer than seven days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's and Construction Manager's written permission.

1.09 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

2.02 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- B. PE Pipe: ASTM D 2513, SDR 11.
 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.

- b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
- c. Aboveground Portion: PE transition fitting.
- d. Outlet shall be threaded or flanged or suitable for welded connection.
- e. Tracer wire connection.
- f. Ultraviolet shield.
- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.03 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Operating-Pressure Rating: 0.5 psig.
 - 4. End Fittings: Zinc-coated steel.
 - 5. Threaded Ends: Comply with ASME B1.20.1.
 - 6. Maximum Length: 72 inches
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- D. Basket Strainers:
 - 1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig.
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.04 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
 1. CWP Rating: 125 psig.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Flow Controls; Conbraco Industries, Inc.
 - c. BrassCraft Manufacturing Co.; a Masco company.

- d. Lyall, R. W. & Company, Inc.
 - e. Perfection Corporation.
2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Lee Brass Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Mueller Co.
 - c. Xomox Corporation.
 2. Body: Cast iron, complying with ASTM A 126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.

6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Flowserve Corporation.
 - c. Homestead Valve.
 - d. Milliken Valve Company.
 - e. Mueller Co.
 - f. R & M Energy Systems; Robbins & Myers.
 2. Body: Cast iron, complying with ASTM A 126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.
 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.06 EARTHQUAKE VALVES

- A. Earthquake Valves, Maximum Operating Pressure of 60 psig: Comply with ASCE 25.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Little Firefighter Corporation, models NAGV, VAGV, and AGV.
 - b. Seismic Safety Products, LLC, Northridge series.
 2. Earthquake valves shall be certified by the State of California.
 3. Maximum Operating Pressure: 60 psig.
 4. Cast-aluminum body with stainless-steel internal parts.

5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.07 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

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. Actaris.
 - b. American Meter Company.
 - c. Invensys.
 - d. Itron Gas.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

2.08 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. HART Industrial Unions, LLC.
 - e. Jomar Valve.
 - f. Matco-Norca.
 - g. Watts; a Watts Water Technologies company.
 - h. Wilkins.
 - i. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a Watts Water Technologies company.
 - e. Wilkins.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.09 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 31 20 00 "Earthwork" for excavating, trenching, and backfilling.
 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.

3.04 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 3. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.05 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.06 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for steel 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 within [**12 inches**] <Insert dimension> of each fitting.
- E. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.08 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.

- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 PAINTING

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (flat).
 - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat).
 - d. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (flat).
 - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
 1. PE pipe and fittings joined by heat fusion, service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be one of the following:
 1. NPS 2 and Smaller: Steel pipe with malleable-iron fittings and threaded joints.
 2. NPS 2-1/2 and Larger: Steel pipe with wrought-steel fittings and welded joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping shall be the following:
 1. NPS 2 and Smaller: Steel pipe with malleable-iron fittings and threaded joints.
 2. NPS 2-1/2 and Larger: Steel pipe with wrought-steel fittings and welded joints.
- B. Aboveground, distribution piping shall be the following:
 1. NPS 2 and Smaller: Steel pipe with malleable-iron fittings and threaded joints.
 2. NPS 2-1/2 and Larger: Steel pipe with wrought-steel fittings and welded joints.

3.15 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
 1. PE valves conforming to CSA standards.
 2. NPS 2 and Smaller: Bronze plug valves.
 3. NPS 2-1/2 and Larger: Cast-iron, lubricated plug valves.

3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
 1. Cast-iron, nonlubricated plug valve.
 2. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
 1. Bronze plug valve.

2. Two-piece, full-port, bronze ball valves with bronze trim.
- C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
 1. Cast-iron, lubricated plug valve.
 2. Two-piece, full-port, bronze ball valves with bronze trim.
- D. Valves in branch piping for single appliance shall be one of the following:
 1. Bronze plug valve.
 2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION

SECTION 23 21 13.13
UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Steel pipes and fittings.
 - 2. Cased piping system.

1.02 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cased piping.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
- C. Shop Drawings: For underground hydronic piping. Signed and sealed by a professional engineer.
 - 1. Calculate requirements for expansion compensation for underground piping.
 - 2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
 - 3. Show pipe sizes, locations, and elevations. Show piping in trench, cased pipe with details showing clearances between piping, and show insulation thickness.

1.03 INFORMATIONAL SUBMITTALS

- A. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.
- B. Qualification Data: For qualified Installer.
- C. Welding certificates.
- D. Material Test Reports: For cased piping.
- E. Source quality-control reports.
- F. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31.9, "Building Services Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:
 - 1. Chilled-Water Piping: 100 psig at 200 deg F.

2.02 STEEL PIPES AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black with plain ends; type, grade, and wall thickness as indicated in "Piping Application" Article.
- B. Cast-Iron, Threaded Fittings: ASME B16.4; Class 125.
- C. Malleable-Iron, Threaded Fittings: ASME B16.3, Class 150.
- D. Malleable-Iron Unions: ASME B16.39; Class 150.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 125; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Steel Welding Fittings: ASME B16.9 and ASTM A 234/A 234M, seamless or welded.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.
- J. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and -bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- K. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.03 CASED PIPING SYSTEM

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Insul-Tek Piping Systems, Inc.
 - b. Perma-Pipe, Inc.
 - c. REHAU.
 - d. Thermal Pipe Systems.
 - e. Uponor.
- B. Carrier Pipe: Schedule 40, steel pipe and fittings.
- C. Carrier Pipe Insulation:
 1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
 - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
- D. Casing: Filament-wound, fiberglass-reinforced polyester resin.
- E. Casing accessories include the following:
 1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
 2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
 3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- F. Manholes: Black steel with lifting eyes.
 1. Finish: Spray-applied urethane, minimum 30 mils thick.
 2. Access: 30-inch-diameter waterproof cover with gasket, ladder, and two 6-inch vents, one high and one low, extending above grade with rain caps.
 3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
 4. Sump: 12 inches in diameter, 12 inches deep.
 5. Floatation Anchor: Oversized bottom keyed into concrete base.
- G. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. See Section 312000 "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATION

- A. Chilled-Water Piping:
 1. NPS 2-1/2 and larger shall be the following:
 - a. Cased piping with polyurethane carrier-pipe insulation.
 - 1) Piping Insulation Thickness: 2 inches.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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 Coordination Drawings.
- B. Remove standing water in the bottom of trench.
- C. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. See Section 230517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.
- I. Secure anchors with concrete thrust blocks. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

3.04 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. 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 unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- F. Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

3.05 IDENTIFICATION

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Section 312000 "Earthwork" for warning-tape materials and devices and their installation.

3.06 FIELD QUALITY CONTROL

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.
- B. Tests and Inspections:
 1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - c. Use vents installed at high points to release trapped air while filling system.
 2. Test hydronic piping as follows:
 - a. Subject piping system to not less than the greater of the following hydrostatic test pressures:
 - 1) 1.5 times the system's working pressure.
 - 2) 100 psi.
 - b. After hydrostatic test pressure has been applied for four hours, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Copper tube and fittings.
 - 2. Steel pipe and fittings.
 - 3. Joining materials.
 - 4. Transition fittings.
 - 5. Dielectric fittings.
 - 6. Bypass chemical feeder.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Bypass chemical feeder.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
- C. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, 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. Other building services.
 - 3. Structural members.
 - 4. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.

- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Preconstruction Test Reports:
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.04 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.05 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on water quality.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Hot-Water Heating Piping: 100 psig at 200 deg F.
 - 2. Chilled-Water Piping: 150 psig at 73 deg F.
 - 3. Makeup-Water Piping: 150 psig at 73 deg F.
 - 4. Condensate-Drain Piping: 180 deg F.
 - 5. Air-Vent Piping: 200 deg F.
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L , and ASTM B 88, Type M.
- B. Wrought-Copper Unions: ASME B16.22.

2.03 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Central Sprinkler Company.
 - b. S. P. Fittings.
 - c. Smith-Cooper International.
 - d. Victaulic Company.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.04 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX USA LLC.
 - c. KBI (King Bros. Industries).
 - d. Viega LLC.
 - 2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX USA LLC.
 - c. KBI (King Bros. Industries).
 - d. NIBCO INC.
 - 2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.06 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. HART Industrial Unions, LLC.

- e. Jomar Valve.
 - f. Matco-Norca.
 - g. Watts; a Watts Water Technologies company.
 - h. Wilkins.
 - i. Zurn Industries, LLC.
2. Description:
- a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a Watts Water Technologies company.
 - e. Wilkins.
 - f. Zurn Industries, LLC.
2. Description:
- a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
- a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.

- e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 - e. Victaulic Company.
 2. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig at 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

2.07 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints (On roof only).
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

- E. Makeup-water piping installed aboveground shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- F. Condensate-Drain Piping:
 - 1. General Use: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Condensing Boiler Condensate-Drain Piping: Schedule 40 CPVC plastic pipe and fittings and solvent-welded joints.
- G. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- H. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- I. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.02 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. 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."
- W. 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."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.03 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric 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.

3.04 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports. Comply with the more stringent requirements of the CMC and this Specification.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 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. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet.
 2. NPS 1: Maximum span, 7 feet.
 3. NPS 1-1/2: Maximum span, 9 feet.
 4. NPS 2: Maximum span, 10 feet.
 5. NPS 2-1/2: Maximum span, 11 feet.
 6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. 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 unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.06 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.07 CHEMICAL TREATMENT

- A. Install bypass chemical feeders in each hydronic system where indicated.
 - 1. Install in upright position with top of funnel not more than 48 inches above the floor.
 - 2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
 - 3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.08 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping
 - 1. Tests shall be made in the presence of the authority having jurisdiction.

2. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 3. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 4. Isolate expansion tanks and determine that hydronic system is full of water.
 5. Subject piping system to not less than the greater of the following hydrostatic test pressures:
 - a. 1.5 times the system's working pressure.
 - b. 100 psi.
 6. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 7. After hydrostatic test pressure has been applied for at least four hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 8. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Hydronic specialty valves.
 - 2. Air-control devices.
 - 3. Strainers.
 - 4. Connectors.
- B. Related Requirements:
 - 1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
 - 2. Section 230523 "General-Duty Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
 - 3. Section 230923 "Direct Digital Control System for HVAC" for automatic control valve and sensor specifications, installation requirements, and locations.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Hydronic Specialty Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Strainers.
 - 4. Connectors.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.05 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.01 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett; a Xylem brand.
 - c. Flow Design, Inc.
 - d. Gerand Engineering Co.
 - e. Grinnell Mechanical Products.
 - f. Griswold Controls.
 - g. HCl; Hydronics Components Inc.
 - h. Nexus Valve, Inc.
 - i. NIBCO INC.
 - j. NuTech Hydronic Specialty Products.
 - k. Oventrop Corporation.
 - l. TACO Comfort Solutions, Inc.
 - m. Tour & Andersson; available through Victaulic Company.
 - n. Tunstall Corporation.
 - o. Victaulic Company.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig (860 kPa).
10. Maximum Operating Temperature: 250 deg F (121 deg C).

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett; a Xylem brand.
 - c. Flow Design, Inc.

- d. Gerand Engineering Co.
 - e. Grinnell Mechanical Products.
 - f. Griswold Controls.
 - g. HCl; Hydronics Components Inc.
 - h. Nexus Valve, Inc.
 - i. NIBCO INC.
 - j. NuTech Hydronic Specialty Products.
 - k. Oventrop Corporation.
 - l. TACO Comfort Solutions, Inc.
 - m. Tour & Andersson; available through Victaulic Company.
 - n. Tunstall Corporation.
 - o. Victaulic Company.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Stem Seals: EPDM O-rings.
 5. Disc: Glass and carbon-filled PTFE.
 6. Seat: PTFE.
 7. End Connections: Flanged or grooved.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. CWP Rating: Minimum 125 psig (860 kPa).
 11. Maximum Operating Temperature: 250 deg F (121 deg C).
- C. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. Armstrong Pumps, Inc.
 - d. Bell & Gossett; a Xylem brand.
 - e. Spence Engineering Company, Inc.
 - f. Watts; a Watts Water Technologies company.
 2. Body: Bronze or brass.
 3. Disc: Glass and carbon-filled PTFE.
 4. Seat: Brass.
 5. Stem Seals: EPDM O-rings.
 6. Diaphragm: EPT.

7. Low inlet-pressure check valve.
 8. Inlet Strainer: <Insert materials>, removable without system shutdown.
 9. Valve Seat and Stem: Noncorrosive.
 10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- D. Diaphragm-Operated Safety Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. Armstrong Pumps, Inc.
 - d. Bell & Gossett; a Xylem brand.
 - e. Spence Engineering Company, Inc.
 - f. Watts; a Watts Water Technologies company.
 2. Body: Bronze or brass.
 3. Disc: Glass and carbon-filled PTFE.
 4. Seat: Brass.
 5. Stem Seals: EPDM O-rings.
 6. Diaphragm: EPT.
 7. Wetted, Internal Work Parts: Brass and rubber.
 8. Inlet Strainer: <Insert materials>, removable without system shutdown.
 9. Valve Seat and Stem: Noncorrosive.
 10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.02 AIR-CONTROL DEVICES

- A. Manual Air Vents:
1. Refer to detail on Drawings.
 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - B. Apollo Valves; Conbraco Industries, Inc.
 - c. Armstrong Pumps, Inc.
 - d. Bell & Gossett; a Xylem brand.
 - e. HCl; Hydronics Components Inc.
 - f. Nexus Valve, Inc.

- g. NuTech Hydronic Specialty Products.
 - h. TACO Comfort Solutions, Inc.
3. Body: Bronze.
 4. Internal Parts: Nonferrous.
 5. Operator: Screwdriver or thumbscrew.
 6. Inlet Connection: NPS 1/2 (DN 15).
 7. Discharge Connection: NPS 1/8.
 8. CWP Rating: 150 psig (1035 kPa).
 9. Maximum Operating Temperature: 225 deg F (107 deg C).
- B. Automatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a Xylem brand.
 - d. Nexus Valve, Inc.
 - e. NuTech Hydronic Specialty Products.
 - f. Spirotherm, Inc.
 - g. TACO Comfort Solutions, Inc.
 2. Body: Bronze or cast iron.
 3. Internal Parts: Nonferrous.
 4. Operator: Noncorrosive metal float.
 5. Inlet Connection: NPS 1/2 (DN 15).
 6. Discharge Connection: NPS 1/4 (DN 8).
 7. CWP Rating: 150 psig (1035 kPa).
 8. Maximum Operating Temperature: 240 deg F (116 deg C).
- C. Bladder-Type Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a Xylem brand.
 - d. Flo Fab.
 - e. TACO Comfort Solutions, Inc.
 2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and

supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a Xylem brand.
 - d. TACO Comfort Solutions, Inc.
2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

E. Air Purgers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a Xylem brand.
 - d. TACO Comfort Solutions.
2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
3. Maximum Working Pressure: 150 psig (1035 kPa).
4. Maximum Operating Temperature: 250 deg F (121 deg C).

2.03 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: Stainless-steel, [20] [40] [60]-mesh strainer, or perforated stainless-steel basket.
 4. CWP Rating: 125 psig (860 kPa).
- B. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (860 kPa).
- C. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig (5170 kPa).

2.04 CONNECTORS

- A. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 2. End Connections: Threaded or flanged to match equipment connected.
 3. Performance: Capable of 3/4-inch (20-mm) misalignment.
 4. CWP Rating: 150 psig (1035 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- B. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
 2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
 3. Performance: Capable of misalignment.
 4. CWP Rating: 150 psig (1035 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.

- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils, where piping cannot be installed with the required grade, and elsewhere as required for air venting. Refer to Section 232113, Hydronic Piping, for pipe grading requirements.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- F. Install expansion tanks where shown on Drawings. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION

SECTION 232123
HYDRONIC PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Separately coupled, base-mounted, end-suction centrifugal pumps.
 - 2. Close-coupled, in-line centrifugal pumps.
 - 3. Automatic condensate pump units.

1.02 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.05 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. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.01 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - 1. Armstrong Pumps, Inc.
 - 2. Crane Pumps & Systems.
 - 3. Grundfos Pumps Corporation.

4. ITT Corporation.
 5. Mepco, LLC.
 6. PACO Pumps; Grundfos Pumps Corporation, USA.
 7. Patterson Pump Company; a Gorman-Rupp company.
 8. Peerless Pump Company.
 9. TACO Comfort Solutions, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and [threaded companion-flange] [flanged] connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 3. Pump Shaft: Steel, with stainless steel shaft sleeve.
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
 5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
- D. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. EPDM coupling sleeve for variable-speed applications.
- E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- G. Motor: Single speed, secured to mounting frame, with adjustable alignment.
1. 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.
 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.02 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:

1. Armstrong Pumps, Inc.
 2. Crane Pumps & Systems.
 3. Grundfos Pumps Corporation.
 4. ITT Corporation.
 5. Mepco, LLC.
 6. PACO Pumps; Grundfos Pumps Corporation, USA.
 7. Patterson Pump Company; a Gorman-Rupp company.
 8. Peerless Pump Company.
 9. TACO Comfort Solutions, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange or union-end connections.
 2. Impeller: Stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Pump Bearings: Permanently lubricated ball bearings.
 6. Provide pump with anti-corrosion coating suitable for marine environment.
 7. Provide pump with integral variable speed drive.
- D. Motor: Single speed and rigidly mounted to pump casing.
1. 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.
 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Totally enclosed, fan cooled.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: Grease-lubricated ball bearings.
 - d. Efficiency: Premium efficient.
- E. Accessories:
1. Provide one mechanical seal for each model type of primary pump.

2. Sediment Separator: Furnish sediment separator for installation on the flushing line between the pump discharge flange and the seal area. The separator shall remove dissolved solids from the flushing medium before the fluid enters the seal area.

2.03 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Beckett Corporation.
 2. Hartell Pumps; Milton Roy.
 3. Little Giant Pump Co.
 4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch-minimum, electrical power cord with plug.

2.04 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
 1. Angle pattern.
 2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
 3. Bronze startup and bronze or stainless-steel permanent strainers.
 4. Bronze or stainless-steel straightening vanes.
 5. Drain plug.
 6. Factory-fabricated support.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting:
 - 1. Refer to details on Drawings.
 - 2. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.03 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install check, shutoff, and throttling valves on discharge side of pumps.
- E. Install suction diffuser and shutoff valve on suction side of pumps.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- I. Ground equipment according to Section 260501 "Basic Electrical Materials and Methods."
- J. Connect wiring according to Section 260530 "Conduit and Wire."

3.05 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.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:

- a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 6. Start motor.
 7. Open discharge valve slowly.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Provide minimum 2 hours training.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.

1.02 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Heat-Pump Applications: 535 psig.
 - 2. Hot-Gas and Liquid Lines: 535 psig.

1.03 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. 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.
 - 2. Show piping size and 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.
 - 3. Show interface and spatial relationships between piping and equipment.
 - 4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.06 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."

1.07 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

1.08 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

2.01 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR. Refer to piping application schedules in PART 3 of this Section.
 - 1. Manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping may be utilized at Contractor's discretion.
 - 2. VRF Systems: Refrigerant piping between outdoor condensing unit and first distribution header shall be hard-drawn copper as specified in this Section. When system manufacturer's installation instructions allow use of refrigerant line-set piping between distribution headers and tees, and air terminal devices, follow instructions for allowable pipe size range and support to avoid forming traps in the piping.
- B. Variable Refrigerant Flow Heat Pump Systems Fittings:
 - 1. For systems manufacturers requiring engineered, pre-assembled headers and branch fittings, Contractor shall obtain such fittings from system manufacturer. Fittings shall be suitable for system type and configuration.
 - 2. VRF Systems: Use of manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping between outdoor condensing units and indoor distribution headers and tees is not allowed. When system manufacturer's installation instructions allow use of refrigerant line-set piping between distribution headers and tees, and air terminal devices, follow instructions for allowable pipe size range and support to avoid forming traps in the piping.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- 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.

2.02 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction, Hot Gas and Liquid Lines, all Sizes, for Heat Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Safety-Relief-Valve Discharge Piping:
- C. Safety relief valve piping shall be as specified for refrigerant piping.

3.02 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 230923 "Direct Digital Control System for HVAC" for solenoid valve controllers and control wiring.
- K. Refer Drawings for sequence of operation.

- L. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- M. 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 083100 "Access Doors and Panels " if valves or equipment requiring maintenance is concealed behind finished surfaces.
- N. Install refrigerant piping in protective conduit where installed belowground.
- O. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- P. Install manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping in rigid or flexible conduit.
- Q. 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.
- R. 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.
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- U. 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."
- V. 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."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.03 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.

2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.04 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, 3/8 inch.
 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 3/8 inch.
 3. NPS 1: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

3.05 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.

3.06 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

SECTION 26 29 23
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification covers complete a variable frequency drives (VFDs) designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD panel. The VFD shall be UL Type 1 for clean environments, or UL Type 12 for dusty environments. The VFD shall have been evaluated by UL and found acceptable for mounting in a plenum or other air handling compartment. Manufacturer shall supply a copy of the UL plenum evaluation upon request.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFD indicated.
 - 1. Include dimensions and finishes for VFDs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each VFD 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.

1.03 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 VFDs.
 - 2. Show VFD 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.
 - 5. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017850 "Operating 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.

1.05 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.

1.06 QUALITY ASSURANCE

- A. The VFD shall be tested to UL 508C. The appropriate UL label shall be applied.
- B. The VFD shall be UL listed for a short circuit current rating of 100 kA and labeled with this rating.
- C. To ensure adequate technical and factory support, VFDs manufactured by others and brand labeled shall not be acceptable.

1.07 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.

1. The complete VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer and not a third party. A written warranty statement shall be provided with the submittals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Danfoss, Inc., VLC HVAC Drive FC 102, or equal by the following:
 1. ABB.
 2. Yaskawa Electric America, Inc.

2.02 GENERAL REQUIREMENTS FOR VFDs:

- A. VFDs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 DESCRIPTION

- A. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating.
- B. The VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- C. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.
- D. The VFD shall have a dual 5 percent impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable. VFDs with saturating (non-linear) DC link reactors shall require an additional 3 percent AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.
- E. The VFD's full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110 percent of rated current for 60 seconds and 120 percent of rated torque for up to 0.5 second while starting.
- F. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160 percent shall be available.

- G. A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings.
- H. The VFD must be able to produce full torque at low speed to operate direct drive fans.
- I. Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.
- J. An automatic motor adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.
- K. Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.
- L. VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.
- M. All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.

2.04 PROTECTIVE FEATURES

- A. A minimum of Class 20 I²t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.
- B. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.
- C. Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.
- D. Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90 percent of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70 percent of the nominal voltage.
- E. Protect from over voltage. The VFD shall continue to operate without faulting with a momentary input voltage as high as 130 percent of the nominal voltage.
- F. The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.
- G. VFD shall include a "signal loss detection" algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.

- H. VFD shall function normally when the keypad is removed while the VFD is running. No warnings or alarms shall be issued as a result of removing the keypad.
- I. VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.
- J. Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.
- K. VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.
- L. If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD's temperature becomes too high.
- M. In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.
- N. The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.
- O. The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.
- P. When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall be programmable to take appropriate protective action when one of the above situations is detected.

2.05 INTERFACE FEATURES

- A. Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.
- B. There shall be an "Info" key on the keypad. The Info key shall include "on-line" context sensitive assistance for programming and troubleshooting.
- C. The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.
- D. Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.
- E. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.
- F. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To

- facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.
- G. Display shall be programmable to communicate in multiple languages including English, Spanish and French.
 - H. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
 - I. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
 - J. A three-feedback PID controller to control the speed of the VFD shall be standard.
 - 1. This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.
 - 2. The VFD shall be able to apply individual scaling to each feedback signal.
 - 3. For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.
 - 4. The VFD's PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.
 - K. The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.
 - L. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
 - M. Five simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.
 - N. Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set "sleep" level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD's speed is being controlled by its PID controller, it shall be possible to program a "wake-up" feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.
 - O. A run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.
 - P. VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F).

- Q. VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.
- R. Standard Control and Monitoring Inputs and Outputs
1. Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
 2. Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.
 3. Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.
 - a. Each relay shall have an adjustable on delay / off delay time.
 4. Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.
 - a. Each shall be independently selectable to be used with either an analog voltage or current signal.
 - b. The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.
 - c. A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.
 - d. The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,
 5. One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.
 6. It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.
 7. It shall be possible to command all digital and analog output through the serial communication bus.
- S. Optional Control and Monitoring Inputs and Outputs
1. It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.
 2. These modules shall use rigid connectors to plug into the VFD's control card.
 3. The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.
 4. Modules may include such items as:
 - a. Additional digital outputs, including relay outputs
 - b. Additional digital inputs
 - c. Additional analog outputs

- d. Additional analog inputs, including Ni or Pt temperature sensor inputs
- 5. It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.
- T. Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Firemode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.
- U. A real-time clock shall be an integral part of the VFD.
 - 1. It shall be possible to use this to display the current date and time on the VFD's display.
 - 2. Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. It shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.
 - 3. All VFD faults shall be time stamped to aid troubleshooting.
 - 4. It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.
 - 5. The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.
- V. The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.
- W. The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include:
 - 1. Comparators for comparing VFD analog values to programmed trigger values
 - 2. Logic operators to combine up to three logic expressions using Boolean algebra
 - 3. Delay timers
 - 4. A 20-step programmable structure
- X. The VFD shall include a Cascade Controller which allows the VFD to operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of 3 additional constant speed motor starters.

2.06 ELECTRO-MECHANICALLY CONTROLLED BYPASS (EMB)

- A. Where scheduled on Drawings, provide VFD unit with bypass function.
- B. Bypass Power Features:
 - 1. Three-Contactor bypass shall be provided that allows operation of the motor via line power in the event of a failure of the VFD. Motor control selection shall be through either a VFD output contactor or a bypass contactor that is interlocked to ensure that both contactors are not energized simultaneously.

2. Main input disconnect shall be provided that removes power from both the bypass and VFD.
 3. VFD-only, fast acting input fuses shall be provided.
 4. Overload protection shall be supplied in bypass mode.
 - a. Adjustable current setting for complete motor protection when operating on line power.
 - b. Overload protection shall include phase loss and phase imbalance protection.
 - c. Visual indication of an overload trip condition shall be displayed on the VFD keypad.
 - d. Resetting an overload trip condition shall not require the opening of the enclosure door for safety reasons and shall be accomplished via a digital input, door mounted device (drive keypad), or over the serial communications.
 5. A third contactor, the drive input contactor, shall be supplied. This allows powering of the VFD with the motor off or operating in bypass mode for testing, programming and troubleshooting purposes.
 6. Main input motor rated fuses that protect the entire package shall be provided.
 7. All panels shall be marked for 100,000 amp short circuit current rating.
- C. Bypass Interface and Control Features:
1. Bypass or VFD selection shall be via a DRIVE – OFF –BYPASS – TEST selector switch.
 2. A BYPASS pilot light will illuminate when operating in bypass mode.
 3. The TEST position shall allow the ability to supply power to the drive for testing purposes while running the motor in bypass.
 4. Selection of Bypass or VFD operation shall be by any one of the following: Manually via the VFD keypad, remotely via a contact closure from the BMS system, commanded over the communication network or automatic bypass operation based on VFD programming.
 5. Bypass package shall include an External Safety interlock that will disable motor operation in either bypass or VFD mode when open.
 6. EMB control package shall be provided. This package includes the following features:
 - a. There shall be complete Common Start/Stop command when operating in either Bypass or VFD mode. While operating in Bypass mode, the keypad shall allow the selection of Hand or Remote motor starting. In Hand and Bypass modes, pushing the keypad start button shall initiate motor operation via line power. When in Remote and Bypass modes are selected, the motor shall start just as it would have in VFD and Remote mode. This start source can be via either a hardwired start command, the VFD's real time clock or a command over BAS communication. Bypass packages that only allow common remote start/stop command when this command is hardwired to the package are not acceptable.
 - b. Selectable Run Permissive logic shall operate in either VFD or bypass operation. When activated, any command to start the motor, in either Hand Bypass, Remote Bypass, Hand VFD or Remote VFD shall not start the motor, but instead close a relay contact that is used to initiate operation of another device, such as an outside air damper. A contact closure from this device shall confirm that it is appropriately actuated and the motor shall then start.

- c. Firemode operation input shall be available. When closed, the motor shall run in bypass mode regardless of operating mode selected and will ignore calls to stop. These include the opening of the external safety interlock circuit or the tripping of the motor overload.
- D. Additional Protective Features:
 - 1. In addition to the power and operational protective features listed above, each bypass shall include the following:
 - a. Low voltage contactor operation shall be maintained to 70% of the package's nominally rated voltage. This will ensure VFD operation on low voltage conditions that would otherwise be interrupted due to contactor dropout.
 - 2. Low voltage contactor operation shall be maintained to 70% of the package's nominally rated voltage. This will ensure VFD operation on low voltage conditions that would otherwise be interrupted due to contactor dropout.

2.07 SERIAL COMMUNICATIONS

- A. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:
 - 1. Johnson Controls Metasys N2
 - 2. Modbus RTU
 - 3. Siemens FLN
- B. Optional communication shall include:
 - 1. LonWorks Free Topology (FTP)
 - 2. BACnet MS/TP
- C. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.
- D. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

2.08 ADJUSTMENTS

- A. The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.
- B. Four independent setups shall be provided.
- C. Four preset speeds per setup shall be provided for a total of 16.
- D. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.

- E. Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.
- F. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.
- G. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
- H. An automatic “start delay” may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.
- I. Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

2.09 OPTIONAL FEATURES

- A. All optional features shall be built and mounted by VFD manufacturer. All optional features shall be UL listed by the VFD manufacturer as a complete assembly and carry a UL label.
- B. All panels shall be marked for their short circuit current rating in compliance with UL.

2.10 SERVICE CONDITIONS

- A. Ambient temperature, continuous, full speed, full load operation:
 - 1. -10 to 45°C (14 to 113°F) through 125 HP @ 460 and 600 volt, through 60 HP @ 208 volt
 - 2. -10 to 40°C (14 to 104°F) 150 HP and larger
- B. 0 to 95 percent relative humidity, non-condensing.
- C. Elevation to 3,300 feet without derating.
- D. AC line voltage variation, -10 to +10 percent of nominal with full output.
- E. No side clearance shall be required for cooling.
- F. All power and control wiring shall be done from the bottom.
- G. All VFDs shall be plenum rated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD 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.

3.02 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 260501 "Basic Electrical Materials and Methods."
- B. Floor-Mounting Controllers: Install VFDs 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. Seismic Bracing: Comply with requirements specified in Section 260500 "Common Work Results for Electrical."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch VFD.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 260501 "Basic Electrical Materials and Methods."
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

3.03 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices and facility's central-control system. Comply with requirements in Section 260530 "Conduit and Wire."
- 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.

3.04 IDENTIFICATION

- A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Section 260500 "Common Work Results for Electrical."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each VFD with engraved nameplate.
 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.05 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. Acceptance Testing Preparation:
 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- D. Tests and Inspections:
 1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFDs will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 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.

3.07 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 Architect before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges
- F. Set field-adjustable pressure switches.

3.08 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 VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs. Provide minimum 2 hours training.
- B. Harmonic filtering. The VFD supplier shall, with the aid of the buyer's detailed electrical power single line diagram showing all impedances in the power path to the VFDs, perform an analysis to initially demonstrate the supplied equipment will meet the IEEE recommendations after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the drive supplier quotation.

END OF SECTION

SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.01 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.
 - 7. Seismic-restraint devices.
- B. Related Sections:
 - 1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 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 CBC and ASCE/SEI 7, as referenced by the CBC.
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.03 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. Sustainable Design Submittals:

1. Product Data: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
 2. Product Data: For adhesives, indicating VOC content.
 3. Product Data: For sealants, indicating VOC content.
- C. 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.
- D. 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.

1.04 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.
7. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.

B. Welding certificates.

C. Field quality-control reports.

A. Welding certificates.

B. Field quality-control reports.

C. Coordinated layout.

1.05 COORDINATED LAYOUT:

- A. Coordinated layouts are required to amplify, expand and coordinate the information contained in the Contract Documents.
- B. Provide minimum 1/4 inch equals one foot scaled coordinated layout drawings showing plan and pertinent section or elevation views of piping, ductwork, equipment, accessories, and electrical systems. Drawings shall be reproducible and work of each trade represented shall be fully coordinated with structure, other disciplines, and finished surfaces. Drawings shall be presented on a single size sheet. Coordinated layout drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to design Drawings.
 1. Provide a stamp or title block on each drawing with locations for signatures from all contractors involved, including but not limited to the General, HVAC, Plumbing, Fire Protection, and Electrical contractors. Include statement for signature that each contractor has reviewed the coordinated layout drawings in detail and has coordinated the work of his trade.
 2. Show on drawings the intended elevation of all ductwork in accordance with the following example:
 - a. B.O.D. = 9'-0"
 - b. OFFSET UP 6"
 - c. B.O.D. = 9'-6"
 3. Highlight, encircle or otherwise indicate deviations from the Contract Documents on the coordinated layouts. Architect will not be responsible for identifying deviations from the original Contract Documents.
- C. Since scale of contract drawings is small and all offsets and fittings are not shown, Contractor shall make allowances in bid for additional coordination time, detailing, fittings, offsets, hangers and the like to achieve a fully coordinated installation. If changes in duct size are

required, equivalent area shall be maintained and the aspect ratio shall not be in excess of 2 to 1 unless approved by the engineer. Drawings shall be submitted for review prior to fabrication and installation. Drawings may be submitted in packages representing at least one quarter of the building ductwork.

- D. Check routing on all ductwork before fabricating. Report any discrepancies to Architect. No extra cost will be allowed for failure to conform to above.

1.06 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.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.02 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." Square elbows with and

without turning vanes will not be allowed. In their place 1-1/2 radius, 1 radius and SMACNA RE-3 elbow will be used in place of square elbows.

2.03 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.
 - 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. Ductmate Industries, Inc.
 - b. Elgen Manufacturing.
 - c. Linx Industries (formerly Lindab).
 - d. McGill AirFlow LLC.
 - e. MKT Metal Manufacturing.
 - f. SEMCO Incorporated.
 - g. Sheet Metal Connectors, Inc.
 - h. Spiral Manufacturing Co., Inc.
 - i. Stamped Fittings Inc.
- 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."

2.04 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. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- 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.

2.05 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, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Provide internal duct lining where indicated on the Drawings, with a minimum of 10'-0" length in each direction from the fan, fan casing, or unit casing. Provide additional lining length where shown. Line all transfer ducts.
 - a. Where ductwork is exposed to weather or outside the building insulation envelope, provide 2 inch thick, 1-1/2 pound density internal lining with matte facing, with an R-Value of 8.0 minimum.
 - b. Where ductwork is within the building insulation envelope, lining shall be 1" thick, 1-1/2 pound density, with R-value of 4.2 minimum.
 - 3. 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.
 - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. Adhesive: As recommended by duct liner manufacturer and with a VOC content of 80 g/L or less.
 - b. Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- 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.

2.06 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. 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.
- C. 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. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. 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.

2.07 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 Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.08 SEISMIC-RESTRAINT DEVICES

- 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. Ductmate Industries, Inc.
 3. Elgen Manufacturing.
 4. Hilti, Inc.

5. Kinetics Noise Control, Inc.
 6. Mason Industries, Inc.
 7. TOLCO.
 8. Unistrut; Part of Atkore International.
 9. Vibration & Seismic Technologies, LLC.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the the Office of Statewide Health Planning and Development for the State of California.
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.
- C. 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.
- D. Restraint Cables: ASTM A 603, galvanized 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.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.
- F. 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

3.01 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 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."

3.02 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.

3.03 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 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.

3.04 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 CBC and ASCE/SEI 7, as referenced by the CBC.
 - 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 evaluation service member of the Office of Statewide Health Planning and Development for the State of California.
- 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.

3.05 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.

3.06 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 099123 "Interior Painting."

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Ductwork Sealing and Leak Testing:
 - 1. All ductwork shall receive a Class A seal.
 - 2. Seal airtight all joints and seams, including standing seams and manufactured joints and seams, of all supply, return and exhaust ducts except those exposed in conditioned space.
 - 3. All duct systems (supply, return, outside air intake, and exhaust), except those identified on compliance forms on Drawings as requiring Acceptance Testing per the requirements of the California Energy Code, shall be tested in accordance with the requirements of SMACNA's "HVAC Air Duct Leakage Test Manual." Test pressure shall be equal to the pressure class of the duct. For additional duct leak testing requirements, refer to Section 230050, "Common Work Results for HVAC Systems," Article, "Acceptance Requirements."
- 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.

3.08 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.
 - 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.

3.09 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated:
- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg .
 - b. SMACNA Leakage Class for Rectangular: 16 .
 - c. SMACNA Leakage Class for Round and Flat Oval: 8 .
 2. Ducts Connected to Constant-Volume Air-Handling Units :
 - a. Pressure Class: Positive 2-inch wg .
 - b. SMACNA Leakage Class for Rectangular: 16 .
 - c. SMACNA Leakage Class for Round and Flat Oval: 8 .
 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg 3-inch wg 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.

- b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16.
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 16
 - c. SMACNA Leakage Class for Round and Flat Oval: 2 8.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg
 - b. SMACNA Leakage Class for Rectangular: 16
 - c. SMACNA Leakage Class for Round and Flat Oval: 8.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
 - 1. Refer to article, Duct Liner.
- H. Elbow Configuration:
 - 1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- I. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Combination fire and smoke dampers.
 - 3. Flange connectors.
 - 4. Duct silencers.
 - 5. Turning vanes.
 - 6. Remote damper operators.
 - 7. Duct-mounted access doors.
 - 8. Duct access panel assemblies.
 - 9. Flexible connectors.
 - 10. Duct accessory hardware.
- B. Related Requirements:
 - 1. Section 233346 "Flexible Ducts" for insulated flexible ducts.
 - 2. Section 284620 "Fire Alarm" for duct-mounted fire and smoke detectors.

1.02 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. 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.

1.03 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. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.

- B. Source quality-control reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.05 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

2.01 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.

2.02 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. 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.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- 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.

2.03 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Aire Technologies.

- b. American Warming and Ventilating; a Mestek Architectural Group company.
 - c. Flexmaster U.S.A., Inc.
 - d. Flex-Tek Group.
 - e. McGill AirFlow LLC.
 - f. Nailor Industries Inc.
 - g. Pottorff.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. 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. Stainless-steel, 0.064 inch thick.
 6. Blade Axles: Stainless steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - 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.
- B. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. American Warming and Ventilating; a Mestek Architectural Group company.
 - b. Flex-Tek Group.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 - h. Vent Products Co., Inc.

2. Comply with AMCA 500-D testing for damper rating.
 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 4. Suitable for horizontal or vertical applications.
 5. Frames:
 - a. Hat shaped.
 - b. 0.05-inch-thick stainless steel.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 6. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Stainless, roll-formed steel, 0.064 inch thick.
 7. Blade Axles: Stainless steel.
 8. Bearings:
 - a. Stainless-steel sleeve.
 - 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.
 9. Blade Seals: Neoprene.
 10. Jamb Seals: Cambered stainless steel.
 11. Tie Bars and Brackets: Aluminum.
 12. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- C. Jackshaft:
1. Size: 0.5-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.04 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Aero-Dyne Sound Control Co.
 - 2. CL WARD & Family Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Duro Dyne Inc.
 - 5. Elgen Manufacturing.
 - 6. Hardcast, Inc.
 - 7. METALAIRE, Inc.
 - 8. SEMCO LLC.
 - 9. Ward Industries; a brand of Hart & Cooley, Inc.
- B. 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.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.05 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Aire Technologies.
 - 2. American Warming and Ventilating; a Mestek Architectural Group company.
 - 3. Cesco Products; a division of MESTEK, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Pottorff.
 - 7. 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 corners and mounting flange.
- F. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel.

- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application[with factory-furnished silicone caulking.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: Modulating or two-position action.
- N. 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.
- O. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Test and reset switches, damper, remote mounted.

2.06 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 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.

2.07 DUCT SILENCERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Dynasonics.
 - 2. McGill AirFlow LLC.
- B. 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.
- C. Shape:
 - 1. Rectangular straight with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, minimum 0.034 inch thick.
- E. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.018 inch thick, perforated.
- F. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss.
- G. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- H. Principal Sound-Absorbing Mechanism:
 - 1. Dissipative type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
- I. 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. Joints: Lock formed and sealed.
 - 2. Reinforcement: Cross or trapeze angles for rigid suspension.
- J. Accessories:
 - 1. Factory-installed end caps to prevent contamination during shipping.
- K. Source Quality Control: Test according to ASTM E 477.
 - 1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
 - 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.08 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Pottorff.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Aluminum.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.09 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 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, "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-inchbutt 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.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 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 0.0428-inch stainless 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.

2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Hardcast, Inc.
 - 2. Ventfabrics, Inc.
 - 3. 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. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. 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.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 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

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.
- C. Install control 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. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire and smoke dampers according to UL listing and CSFM listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. At outdoor-air intakes and mixed-air plenums.
 - 3. At drain pans and seals.
 - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 5. 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.
 - 6. At each change in direction and at maximum 50-foot spacing.
 - 7. Upstream and downstream from turning vanes.
 - 8. Upstream or downstream from duct silencers.
 - 9. Control devices requiring inspection.
 - 10. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. 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.

- J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.

3.02 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 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

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Insulated flexible ducts.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product data showing compliance with ASHRAE 62.1.
 - 2. Product Data: For adhesives and sealants, indicating VOC content.
- C. Shop Drawings: For flexible ducts.
 - 1. Include plans showing locations and mounting and attachment details.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.

PART 2 - PRODUCTS

2.01 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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.02 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.03 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Flexmaster U.S.A., Inc.
 2. JP Lamborn Co.
 3. McGill AirFlow LLC.
 4. Thermaflex; a Flex-Tek Group company.
 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized 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: R4.2.

2.04 FLEXIBLE DUCT CONNECTORS

- A. 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.
- B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install flexible ducts 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 in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
 1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- H. Supporting Flexible Ducts:
 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.

2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 233423
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Centrifugal roof ventilators.

1.02 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
- 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.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans 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. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Field quality-control reports.

- C. Roof Curb Data: For roof mounted equipment where combined weight of equipment unit and roof curb or rail exceeds 400 pounds, submit calculations from manufacturer for roof curbs proving compliance with the seismic requirements of the 2016 CBC, and ASCE 7-10. Manufacturer shall certify that roof curbs are suitable for use indicated on Drawings and in Specifications for the seismic design category indicated in structural Contract Documents. Calculations shall be stamped and signed by a State of California registered structural engineer.
- D. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.06 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.07 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.02 CENTRIFUGAL ROOF VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - 1. American Coolair Corporation.
 - 2. Loren Cook Company.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
1. Resiliently mounted to housing.
 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 5. Fan and motor isolated from exhaust airstream.
- E. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in raised cant and mounting flange.
 2. Overall Height: 12 inches.
 3. Sound Curb: Curb with sound-absorbing insulation.
 4. Pitch Mounting: Manufacture curb for roof slope.
 5. Metal Liner: Galvanized steel.
- G. Controls: Refer to control diagrams on Drawings and to Section 230923, "Direct Digital Control System for HVAC."

2.03 MOTORS

- A. Electrically commutated motor.
- B. 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.

- C. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to article, Single-Phase Motors, in Section 23 05 13, Common Motor Requirements for HVAC Equipment.

2.04 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounted fans to roof curbs with stainless steel hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260530 "Conduit and Wire."
- D. Connect wiring according to Section 260530 "Conduit and Wire."

3.03 FIELD QUALITY CONTROL

- 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.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system.

5. Adjust damper linkages for proper damper operation.
 6. Verify lubrication for bearings and other moving parts.
 7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 9. Shut unit down and reconnect automatic temperature-control operators.
 10. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.

END OF SECTION

SECTION 233600
AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Shutoff, single-duct air terminal units.
 - 2. Casing liner.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
- C. Shop Drawings: For air terminal units.
 - 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 each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- D. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 2. Include design calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.04 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. Size and location of initial access modules for acoustic tile.
 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 4. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Field quality-control reports.
- C. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017850 "Operating and Maintenance Data," include the following:
 - a. Instructions for resetting minimum and maximum air volumes.
 - b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- 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: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
1. Anemostat Products; a Mestek company.
 2. Carnes Company.
 3. ENVIRO-TEC; by Johnson Controls, Inc.
 4. Krueger.
 5. Nailor Industries Inc.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 22 gage galvanized steel, single wall.

1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections, size matching inlet size.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from zero to 140 deg F, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 3 percent of nominal airflow at 6-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- F. Attenuator Section: 0.034-inch steel sheet.
1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- G. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- H. Control devices shall be as specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
1. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

2.03 CASING LINER

- A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Minimum Thickness: 1 inch.
 - a. Maximum Thermal Conductivity:
 - 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. Adhesive shall have a VOC content of 80 g/L or less.
 - b. product requirements of South Coast Air Quality Management District, Rule 1168.

2.04 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- 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 and for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.02 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with CBC and ASCE/SEI 7, as referenced by the CBC. Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- 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 air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by the Office of Statewide Health Planning and Development for the State of California.

- 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 before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify 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. Install heavy-duty sleeve anchors 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.

3.03 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.04 CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.05 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.06 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 the following tests and inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils 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 proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.07 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.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.
 - 7. .

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Provide minimum 2 hours training.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Submittal and installation requirements for diffusers, registers, and grilles.
 - 2. Perforated diffusers.
 - 3. Linear bar diffusers.
 - 4. Linear slot diffusers.
 - 5. Fixed face registers and grilles.
 - 6. Linear bar grilles.
- B. Related Requirements:
 - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.02 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.

1.03 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.
 - 6. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 DIFFUSERS, REGISTERS, AND GRILLES

- A. Diffusers, registers, and grilles manufacturers and models are specified on Drawings.

2.02 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

3.01 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.

3.02 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.
- D. Unless otherwise indicated on Drawings, provide rectangular galvanized steel plenum on top of each diffuser and ceiling return for connection to ductwork. Line plenum with internal insulation as indicated for lined ductwork. Size plenum to allow full opening into air terminal. Plenum sheet metal gauge shall be equal to gauge for rectangular equivalent of the branch duct serving the air inlet or outlet.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 41 00
PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flat panel filters.
 - 2. Pleated panel filters.
 - 3. Filter gages.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - 3. Wiring Diagrams: For power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.04 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. Provide one complete set(s) of filters for each filter bank. If system includes prefilters, provide only prefilters.

1.05 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. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
 - 2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

- C. Comply with NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.01 FLAT PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames.
 - 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. AAF International.
 - b. Camfil Farr.
 - c. Flanders Corporation.
 - d. Purafil, Inc.
- B. Filter Unit Class: UL 900, Class 2.
- C. Media: Interlaced glass or synthetic fibers or Cotton and synthetic fibers coated with nonflammable adhesive.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. 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."
 - 3. Media shall be coated with an antimicrobial agent.
 - 4. Metal Retainer: Upstream side and downstream side.
- D. Filter-Media Frame: Cardboard with perforated metal retainer sealed or bonded to the media.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
 - 1. MERV Rating: As specified or scheduled for specific equipment, and tested according to ASHRAE 52.2.

2.02 PLEATED PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
 - 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. AAF International.
 - b. Camfil Farr.
 - c. Flanders Corporation.
- B. Filter Unit Class: UL 900, Class 2.

- C. Media: Interlaced glass or synthetic fibers or Cotton and synthetic fibers coated with nonflammable adhesive.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Media shall be coated with an antimicrobial agent.
 - 3. Separators shall be bonded to the media to maintain pleat configuration.
 - 4. Welded wire grid shall be on downstream side to maintain pleat.
 - 5. Media shall be bonded to frame to prevent air bypass.
 - 6. Support members on upstream and downstream sides to maintain pleat spacing.
- D. Filter-Media Frame: Cardboard frame with perforated metal retainer with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles sealed or bonded to the media.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
 - 1. Minimum MERV Rating: As specified or scheduled for specific equipment, and tested according to ASHRAE 52.2.

2.03 FILTER GAGES

- A. Diaphragm-type gage with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
 - 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. Airguard.
 - b. Dwyer Instruments, Inc.
 - 2. Diameter: 2 inches.
 - 3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg or Less: 0- to 0.5-inch wg.
 - 4. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1.0-Inch wg or Less: 0- to 1.0-inch wg.
 - 5. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg or Less: 0- to 2.0-inch wg.
 - 6. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0- to 3.0-Inch wg or Less: 0- to 3.0-inch wg.
- B. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.

- C. Install filter gage for each filter bank.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- E. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- F. Coordinate filter installations with duct and air-handling-unit installations.

3.02 TEMPORARY (CONSTRUCTION PERIOD) FILTERS:

- A. Install new temporary filters in all units that have filter systems installed. Temporary filters shall match the permanent filters that are specified for the units. Replace filters as needed, in accordance with manufacturer's directions, in order to provide protection for the unit prior to occupancy by the Owner. Provide new filters prior to air system balancing.
- B. If air handling units are operated during construction of the project, install temporary filters directly over each return air inlet. Filters shall match the permanent filters that are specified for the units. Select size of filter to completely cover the frame of the return air inlet, and tape filters firmly in place to eliminate any construction debris from entering the duct system or unit. Remove the temporary filters upon completion of the work, and repair all damaged paintwork.

3.03 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Test for leakage of unfiltered air while system is operating.
- B. Air filter will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.04 CLEANING

- A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 23 51 23

GAS VENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Listed double-wall vents.
 - 2. Boiler air intake piping.

1.02 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 product.
- B. Shop Drawings: For vents.
 - 1. Include plans, elevations, sections, 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. Detail fabrication and assembly of hangers and seismic restraints.

1.03 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

PART 2 - PRODUCTS

2.01 LISTED TYPE B VENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1. Heat-Fab, Inc.
 - 2. Metal-Fab, Inc.
 - 3. Selkirk Corporation.
- B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B; with neutral or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.
- D. Inner Shell: ASTM A 666, Type 430 stainless steel.
- E. Outer Jacket: Galvanized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

2.02 LISTED SPECIAL GAS VENTS – BOILER APPLICATION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 1. Heat-Fab, Inc. (Selkirk Corporation), model Saf-T Vent.
 2. Metal-Fab, Inc..
 3. ProTech Systems.
 4. Securities Chimneys International.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211. Vents shall be listed in boiler manufacturer's literature as acceptable for the boiler model scheduled on Drawings.
- C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.
- D. Inner Shell: ASTM A 959, Type AL29-4C stainless steel.
- E. Outer Jacket: Stainless steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, storm collars, support assemblies, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Provide boiler connection adapter of same manufacture as venting system, and listed as acceptable in boiler manufacturers literature.
 1. Termination: Vent manufacturers' recommended cap designed to exclude minimum 90 percent of rainfall. Termination caps shall comply with boiler manufacturers' recommendations and shall be listed in boiler manufacturer's literature as acceptable for the boiler model scheduled on Drawings.
 2. Condensate trap kit.

2.03 COMBUSTION AIR INTAKE PIPING – BOILER APPLICATION

- A. Schedule 40, CPVC Plastic Pipe: ASTM F 441/F 441M.
 1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40.
- B. Joining Materials:
 1. Solvent Cements for CPVC Piping: ASTM F 493.
 - a. Solvent cement shall have a VOC content of 490 g/L or less.
 - b. Solvent cement shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 2. Adhesive primer shall have a VOC content of 550 g/L or less.
 3. Adhesive primer shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATION

- A. Listed Type B Vents: Vents for certified gas appliances.
- B. Listed Special Gas Vent: Boiler flue.
- C. CPVC: Boiler combustion air intake.

3.03 INSTALLATION OF LISTED VENTS

- A. Comply with requirements of boiler and vent system manufacturers.
- B. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- C. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- D. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- E. Lap joints in direction of flow. Slope vent towards appliance.
- F. Install condensate trap kit and drain to receptacle.

3.04 PIPE JOINT CONSTRUCTION

- A. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.05 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION

SECTION 23 52 16
FIRE-TUBE CONDENSING BOILERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, vertical, fire-tube condensing boilers, trim, and accessories for heating hot water.

1.02 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Source quality-control test reports: Indicate and interpret test results for compliance with performance requirements before shipping.
- D. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.
- E. Warranty: Standard warranty specified in this Section.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Proposed models shall meet an established minimum manufacturer's production period of 5 years.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code and so labeled with National Board Registration.
- D. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- E. AHRI Compliance: Boilers shall be AHRI listed and must meet the minimum efficiency specified under AHRI BTS-2000 as defined by Department of Energy in 10 CFR Part 431.
- F. ANSI Compliance: Boilers shall be compliant with ANSI Z21.13 test standards for US.
- G. CSA/UL Compliant: Boilers shall be compliant with CSA certification or UL listed.
- H. All boiler models under 2,000 MBH shall be pre-certified with SCAQMD under Rule 1146.2. Units under 75,000 BTU must be compliant with Rule 1121.

1.05 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.06 WARRANTY

- A. Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Fire-Tube Condensing Boilers:
 - a. Heat Exchanger, Pressure Vessel and Condensation Collection Basin shall carry a 10 year limited warranty against defects in materials or workmanship and failure due to thermal shock.
 - b. All other components shall carry a two year warranty from date of boiler start up.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 - 1. AERCO.
 - 2. Cleaver-Brooks.
 - 3. Fulton.

2.02 CONSTRUCTION

- A. Description: Boiler shall be natural gas fired, fully condensing, vertical, fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections. Boiler shall be furnished with a negative regulated, fan assisted low NOx burner, automatic combustion system, safeties, controls, accessories and trim.
- B. Heat Exchanger: Vertical single pass counter flow design. Heat exchanger shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded 316L or 304 welded stainless steel and of fire tube design.
 - 1. Stainless steel fire-tubes capable of thermal expansion and contraction and welded into ASME grade top and bottom tube plates.
 - 2. Minimum Flow and Volume:
 - a. Minimum flow rate for models less than 1,500 MBH shall be no greater than 18 GPM.
 - b. Minimum flow rate for models greater than 1,500 MBH shall be no greater than 25 GPM.
 - c. Minimum acceptable heat exchanger water volume of 1 US Gallon per 20,000 BTU input on all units over 1,000 MBH.

- C. Condensate collection pan shall be solid 316L or 439 stainless steel of welded construction without bolts, gaskets or O-rings..
- D. Intake Filter and Dirty Filter Switch: Boiler shall include an intake air filter with a factory installed air pressure switch. Boiler display screen shall alert the end user that the intake filter is dirty and needs to be changed.
- E. Pressure Vessel: The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall be designed for single-pass water flow.
- F. Gas Train, Burner and Combustion System: Negative Regulated Fan Assist Low NOx:
 - 1. Burner: Natural gas, forced draft single burner premix design. Burner shall be high temperature stainless steel with a woven outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency, ignition failures or flame rectification failures on run. The burner shall have an independent laboratory rating for Oxides of Nitrogen (NOx) to meet requirements of South Coast Air Quality Management District (SCAQMD) as compliant with Rule 1146.2.
 - a. Boilers greater than 1,000 MBH will have a minimum 20:1 burner modulation down to 5 percent input.
 - b. Negative regulated fan assist gas train using pulse width modulation fan signal and (2) gas valve firing system.
 - 1) Low Fire gas valve shall track firing rates less than 50 percent for operation without flame rectification loss.
 - 2) High Fire gas valve shall track firing rates greater than 50 percent for operation without flame rectification loss.
 - 2. Gas train shall be equipped with High/Low Gas Pressure Switches, manually reset safety switched as required by CSD-1.
 - 3. Combustion System will employ a flame safeguard system in compliance with CSD-1.
 - 4. Ignition/Flame Supervision: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
 - 5. Boilers shall be able to operate within a dynamic range of 4 inch w.c.- 14 inch w.c. low gas pressure.
- G. Blower: Boiler shall be equipped with a pulse width modulating blower system to control the fuel/air mixture to provide modulating boiler firing rates from 5 percent to 100 percent. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.
 - 1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- H. Gas Train: The boiler shall be supplied with two gas valves designed with negative pressure regulation and shall be capable of the following minimum turndowns:
- I. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- J. Casing:
 - 1. Jacket: Heavy gauge primed and painted steel jacket with snap-in closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.

3. Insulation: Minimum 1/2 inch thick, mineral fiber insulation surrounding the heat exchanger.
4. Combustion-Air Connections: Inlet and vent duct collars.

2.03 TRIM

- A. Safety Relief Valve:
 1. Size and Capacity: 50 lb.
 2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
- B. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.
- C. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.
- D. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

2.04 ACCESSORIES

- A. Provide unit with kit required for outside installation.

2.05 CONTROLS

- A. Refer to Section 23 09 23 "Direct Digital Control System for HVAC."
- B. Boiler controls shall feature a standard, factory installed LCD screen display with the following standard features:
 1. Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger. The boiler shall be able to operate in this mode with a minimum temperature rise of 20 degrees F and a maximum temperature rise of 60 degrees F.
 2. Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
 3. BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
 4. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, hours running and ignition attempts and should be able to view on boiler screen.
 5. Boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. Factory installed, internal cascade controller shall include: Lead-Lag, Parallel Modulation, Series Modulation, Rotation of Lead Boiler, Set-Point Adjustment.
 6. Controller shall have an outdoor reset feature to reset water temperature based on outdoor air temperature.

7. Controller shall have a night time setback feature programmable to lower water temperature during non-occupancy periods.
8. Burner Control:
 - a. High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
 - b. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
 - c. Blocked Air Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 - d. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
 - e. Blocked Condensate Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
 - f. Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.
 - g. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.
- C. Building Automation System Interface: Factory installed Modbus gateway interface to enable building automation system to monitor, control, and display boiler status and alarms. BACnet MS/TP will be standard.

2.06 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.
- B. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
- C. Electrical Characteristics:
 1. Refer to schedule on Drawings

2.07 VENTING

- A. Exhaust flue must be UL listed, Category IV approved stainless steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boilers exhaust vent length must be able to extend to 100 equivalent feet. Refer to Section 23 51 23, "Gas Vents," for exhaust flue materials.
- B. Intake piping shall be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length shall be able to extend to 100 equivalent feet. Refer to Section 23 51 23, "Gas Vents," for intake piping and joining methods.
- C. Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.

- D. Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided control display.
- E. Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved manufacturers.

2.08 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in of piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BOILER INSTALLATION

- A. Install equipment on 4" concrete housekeeping pad. Refer to detail on Drawings.
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.

3.03 CONNECTIONS

- A. Install boilers level on concrete bases. Concrete materials and installation requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of equipment connection. Provide a reducer if required.
- E. Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
 2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Gas Vents."
- H. Ground equipment according to Section 26 05 30 "Conduit and Wire."
- I. Connect wiring according to Section 26 05 30 "Conduit and Wire."

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
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.
- B. Tests and Inspections:
1. Perform installation and startup checks according to manufacturer's written instructions. Complete startup form included with Boiler and return to Manufacturer as described in the instructions.
 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.
- D. Performance Tests:
1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
 3. Perform field performance tests to determine capacity and efficiency of boilers.
 4. Repeat tests until results comply with requirements indicated.
 5. Provide analysis equipment required to determine performance.
 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
 7. Notify Architect in advance of test dates.
 8. Perform a combustion analysis after installation and adjust gas valve per the Installation and Operations manual and note in startup report.
 9. Document test results in a report and submit to Architect.

3.05 DEMONSTRATION

- A. Engage a factory representative or a factory-authorized service representative for boiler startup and to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Specifications. Provide minimum 2 hours training.

END OF SECTION

SECTION 23 73 13
CUSTOM AIR HANDLING UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Custom variable volume air handling units.

1.02 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include motor ratings, electrical characteristics, and motor accessories.
6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include dampers, including housings and linkages.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other details, drawn to scale, showing the items described in this Section, and coordinated with all building trades. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- B. Sample Warranty: For manufacturer's warranty.
- C. Source quality-control reports.
- D. Startup service reports.
- E. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.05 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.

1.06 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. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1- 2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.07 WARRANTY

- A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Scott Springfield.
 - 2. Haakon.
 - 3. Climate Craft.

2.02 UNIT CONSTRUCTION

- A. Unit Base:
 - 1. Each unit shall be constructed on a base fabricated from ASTM A36 welded structural steel channel. Tubular or formed metal channel bases are not acceptable.
 - 2. Maximum Deflection: L-200.
- B. Unit Cabinet

1. Housing: The unit housing side and roof panels shall be constructed of 16-gauge galvanized steel, and shall utilize a standing seam modular panel type construction. All floors shall be constructed of 14-gauge galvanized steel. The panels shall be caulked and attached to each other, to the roof, and to the floor using nuts and bolts on no less than 8 inches on center. Drive screw attachment is not acceptable. All panels shall be removable. All seams shall be sealed with an acrylic latex sealant prior to assembling the panels and after completion of the assembly. All floor openings shall have 12-gauge galvanized steel-framed flange around the entire perimeter of opening for duct connection.
2. Insulation and Interior Liner: Insulation shall be 2 inches thick, 3 lbs per cubic foot density, neoprene coated fiberglass to cover all walls and ceilings. Insulation shall meet NFPA-90A smoke and flame spread requirements. All floors shall be insulated from below using minimum 2 inch thick foam to ensure that the entire under surface of the floor is insulated. There shall be no raw edges of insulation exposed to the air stream. The entire interior of all units shall be lined with minimum 20 gauge galvanized steel liner. The interior liner of the fan sections, inlet plenum sections, and discharge plenum sections shall be perforated and the remaining shall be steel.
3. Drain Pans: Drain pans shall be constructed from 16-gauge, 316 stainless steel. Drain pan shall be insulated with minimum 2 inch thick foam insulation. Drain pans shall be sized such that the entire coil, including headers and return bends, are inside the drain pan. Drain pans shall slope in two directions so there is no standing water in drain pan. Stainless steel condensate connection shall be provided on one side of the unit.

C. Access Doors

1. All access doors shall be of thermal break construction, hinged, double wall, insulated, man size access doors shall be provided in all sections requiring access for maintenance or service. The frame shall be constructed of extruded aluminum, fully welded at the corners with an anodized finish. The doors shall utilize a dual gasket seal system. All hardware provided shall be non-corrosive and all hinges and latches shall be adjustable with nuts and bolts. Access door must not leak more than 25 CFM at 6 inches static pressure.
2. Door hinges and latches shall be adjustable, without the use of shims or special tools, to allow for a tight seal between the door and the doorframe. The door hinge design shall allow for field reversing of door swing and doors shall be removable. Provide door detail drawing with submittal package.
3. Doors providing access to any section of the air handler that contains rotating fans shall be provided with a door interlock safety switch to de-energize the fan motor upon opening. Each fan section shall include an 8 inch x 12 inch wire reinforced UV protected glass view window in the access door.

D. Paint Finish

1. After final assembly the unit exterior shall be coated with an industrial grade self-priming semi-gloss high solids polyurethane gray finish. All fan bases, springs, and structural steel supports shall be coated with the same finish. The paint system shall meet ASTM B117 Salt spray test for a minimum of 2000 hours.

2.03 INTERNAL COMPONENTS

A. Fan Assembly

1. Supply and return fans shall be direct drive Arrangement No. 4 plenum fans. Fan wheel shall be aluminum with aluminum extruded airfoil blades. The fan inlet shall be isolated from the cabinet by means of a neoprene-coated flexible connection. Plenum fans shall be provided with spring-style thrust restraints.
2. Each fan shall be sized to perform as indicated on the Drawings equipment schedule. The wheel diameter shall not be less than that shown on the equipment schedule. Fans shall be tested in accordance with AMCA 210 and AMCA 301 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air. Fans shall have a sharply rising pressure characteristic extending through the operating range and continuing to rise beyond the efficiency peak to ensure quiet and stable operation. Fans shall have a non-overloading design with self-limiting horsepower characteristics and shall reach a peak in the normal selection area. All fans shall be capable of operating over the minimum pressure class limits, as specified in AMCA Standard 2408-69.
3. Fan Base, Spring Isolation, and Support Framing: Mount fan and motor on an internal, fully welded, rigid steel base. Base shall be free-floating at all four corners on spring type isolators with earthquake restraints. The fan assembly shall be isolated from the cabinet by steel springs with minimum deflection of 2.0 inches or as indicated on schedules. The spring isolators shall be mounted to structural steel members. All isolators shall be rated for zone 4 seismic requirements. The spring isolators shall be mounted on a waffle pad for vibration isolation.
4. Balancing: All fans prior to shipment shall be completely assembled and test run as a unit at the specified operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained and a written copy shall be available upon request.

B. Motors:

1. Furnish premium-efficiency TEFC, NEMA frame, ball bearing type motors. TECO, Marathon "XRI", or Reliance "XE" Premium Efficiency are acceptable. The Horsepower values as shown on the schedule are minimum allowable.
2. The fan motors shall be factory wired to an external VFD with flexible conduit of adequate length so that it will not have any effect on the vibration isolation.

C. Fan Airflow Measurement:

1. Manufacturer shall be Ebtron, Fan Inlet Hybrid Series or equal.
2. Each fan shall have a sensor face mounted at the inlet cone. Sensor shall not affect fan performance or sound. Each sensor node shall be shall contain two individually wired, hermetically sealed bead-in-glass thermistors. Airflow accuracy shall be plus

or minus 2 percent of reading over the entire operating airflow range of not less than 0 to 5,000 fpm.

3. A single transmitter shall be provided for each bank of fans with an integral, minimum 16-character LCD display capable of simultaneously displaying total airflow and temperature. The LCD display shall also be capable of displaying individual fan airflow and temperature readings of each independent sensor node.
4. Output signal 4-20 mA. DC or 0-5 VDC standard.
5. The transmitter shall be housed in a NEMA 1 enclosure with external signal tubing, power and output signal connections.

D. Coils

1. Chilled water coils shall be of the plate fin extended surface type. Tubes shall be 5/8 inch outside diameter seamless copper with a 0.020 inch minimum wall thickness. Each coil shall have individually replaceable return bends of 0.025 inch wall thickness on both sides of the coil. Coils incorporating a "hairpin" type design are not acceptable. Tubes shall be expanded into the fin collars to provide a permanent mechanical bond.
2. The secondary surface shall be formed of 0.008 inch aluminum fins and shall be spaced not closer than 12 fins per inch with integral spacing collars that cover the tube surface. Headers shall be non-ferrous seamless copper, outside the air stream and provided with brazed copper male pipe connections. Drain and vent tubes shall be extended to the exterior of the air handling unit.
3. All coils shall have counter flow construction with connections left or right hand as shown on the drawings. The use of internal restrictive devices to obtain turbulent flow will not be accepted.
4. Cooling coil casings shall be of minimum 16-gauge, 316 stainless steel with double-formed 1-1/4 inches stacking flanges and 3/4 inch flanges on the side plates. All other coil casing shall be of 16-gauge galvanized steel. Flanged tube sheets shall have extruded tube holes. Reinforcing shall be furnished so that the unsupported length is not over 60 inches. All coil assemblies shall be tested under water at 300 psi and rated for 150-psi working pressure. Headers are to be located inside the cabinet casing with only the pipe connections extending through the casing. All sides of coils shall be carefully blanked off with the same materials used for the coil casings, to ensure all air passes through the coil.
5. Intermediate condensate pans are to be furnished on multiple coil units and single coils greater than 48 inches high. The pans shall be 16 Ga. 304 stainless steel and drain to the main drain pan through copper downspouts.
6. All water coils shall be rated in accordance with ARI Standard 410.

E. Filters

1. Filter sections shall be fabricated as part of the air-handling unit. Filters shall be arranged for upstream loading as shown on the drawings. Provide filter-holding frames to accommodate scheduled filters. Filter frames shall be 16 Ga. galvanized steel and shall be fully welded to reduce leakage of air through corners.

2. Factory install at each filter bank a Dwyer Magnehelic "Series 2000 ASF," or equal pressure gauge complete with signal flags, static pressure tips, hardware and fittings. Enclose the gauge in a protective sheet metal box with a hinged inspection door. Paint to match unit
3. Filter shall be mini-pleat high-efficiency, extended media area, totally rigid and disposable type. Air filters shall be MERV 13 and have average efficiency of not less than 85 percent when tested in accordance with ASHRAE 52-76 test standard. Filter pressure drop shall not exceed 0.30 inches at 500 FPM when clean. Filter shall be of the quantities and sizes as indicated on the drawings

F. Economizer Section

1. Economizer section shall include dampers for return air, fresh air and exhaust air. Dampers shall be opposed blade type. Dampers shall be sized for not greater than 1200 fpm face velocity based upon gross damper area. Dampers shall meet above specifications. Furnish full height 24 inches wide access doors for damper and linkage service.
2. Dampers shall be supplied with low leak extruded aluminum airfoil blades. Blades shall be supplied with rubber edge seals and stainless steel arc end seals. Rubber edge seals shall be backed by the damper blade to assure a positive seal in the closed position. Dampers shall be provided with nylon bearings within extruded openings. Damper leakage shall not exceed 6 CFM/ft² at 5.0 inches of static pressure. Leakage testing shall be in accordance with AMCA standard 500 figure S.S. Test results must be from independent testing laboratory.

G. Outside Air Monitoring System

1. EBTRON, Inc. Model GTC116-PC is basis of design. (ATMD)
 - a. Products submitted as equal in non-conformance with the requirements of this specification will not be considered.
 - b. Any product submitted as an equal shall comply with all performance, capabilities and functional aspects of this specification.
2. Each ATMD shall consist of one or more sensor probes and a single, remotely mounted, 32 bit microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor nodes contained in one or more probe assemblies per
3. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tubes. All internal wires within the tube shall be Kynar coated. PVC insulated conductors are not acceptable.
4. Each sensor node shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
5. Thermistors shall be mounted in the sensor node using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment. Thermistors leads shall not be fastened to the thermistor semiconductor substrate by weld or solder connections. Manufacturer shall provide UL listed, FEP jacketed, plenum rated cable(s) between sensor probes and the remote transmitter.

6. The airflow rate at each sensor node shall be equally weighted and arithmetically averaged by the transmitter prior to output. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
7. Each sensing node shall be individually wind tunnel calibrated at 16 points to NIST traceable airflow standards. Airflow accuracy shall be plus or minus 2 percent of reading over the entire operating airflow range of not less than 0 to 5,000 fpm (25.4 m/s).
8. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. Individual airflow and temperature readings of each independent sensor node shall be accessible. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display.
9. The ATMD shall be UL 973 and BTL listed
10. The transmitter shall have two isolated and fused analog output signals and one RS-485 network connection. One analog output shall be for velocity and the other for a temperature output or LEE D alarm function. All transmitters shall have integral self diagnostics.
11. Other than the thermistor sensors, no other electronic components shall be located at the sensing node. Signal processing circuitry on or in the sensor probe shall not acceptable.
12. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable.
13. Devices with RJ-45 connections exposed to the environment or having electronic circuitry mounted in or at the sensor node are not acceptable.
14. Pitot tubes and arrays are not acceptable.
15. Vortex shedding devices are not acceptable.

H. Electrical Requirements

1. All AHU and electrical panel wiring shall be performed in a UL 508 listed shop. Provide single source power panels (SSPP's) that are constructed according to NEC regulations and carry a U.L.508 listing and label and installed in a NEMA3R enclosure. The panel shall include a non-fused main disconnect switch covering all fans in each unit, Motor Starters for constant volume units or VFD's for variable volume units, and any necessary transformers, Hand-Off-Auto switches, relays and pilot lights for complete operation of the fans in the unit. The single source power panels shall be factory wired to all factory furnished devices such as motors and interlocks.
2. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all electrical panel assemblies supplied for the air handlers. The air handling unit manufacturer shall be a U.L. 508 listed panel shop.
3. The main control panel shall have access door(s) for direct access to the controls. The panel shall contain a single externally operated, non-fused disconnect, suitable for copper wire up to and including 3 inches diameter conduit. Connect separate 460/3/60 power to the single source power panel.

4. All wiring shall be run in EMT conduit, (or flexible when connecting to a motor), raceways are not acceptable.
 5. Provide fluorescent, marine style lights in each access section wired to a common weatherproof switch with 60-minute timer mounted adjacent to the supply fan access door. 120V GFI duplex service receptacles shall be installed and wired with the lighting circuit and located in each fan compartment.
 6. If the unit requires splits, junction boxes shall be furnished on each section to allow the electrical contractor to make final connections in the field. Wiring shall be clearly labeled to allow ease in final interconnections.
- I. Variable Frequency Drives
1. Furnish complete individual variable frequency VFDs for each fan designated on the drawing schedules to be variable speed to be installed inside the unit's vestibule. Comply with requirements in Section 232923, "Variable Frequency Motor Controllers."

2.04 CONTROLS

- A. Refer to control diagrams on Drawings and to Section 230923, "Direct Digital Control System for HVAC."

2.05 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Unit Support: Install unit level on concrete structural pads. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of concrete structural pads with actual equipment provided.

- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- D. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.03 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to air-handling unit, allow space for service and maintenance.
- C. Connect condensate drain pans using size shown on Drawings, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

3.04 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 01 "Basic Electrical Materials and Methods."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to 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 Division 26 Sections.

3.05 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 26 05 30 "Conduit and Wire."

3.06 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.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.

4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 6. Verify that zone dampers fully open and close for each zone.
 7. Verify that face-and-bypass dampers provide full face flow.
 8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
 9. Comb coil fins for parallel orientation.
 10. Verify that proper thermal-overload protection is installed for electric coils.
 11. Install new, clean filters.
 12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.07 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. 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.

3.08 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.09 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. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units. Provide minimum 2 hours training.

END OF SECTION

SECTION 23 81 26.13

VARIABLE REFRIGERANT FLOW SPLIT-SYSTEM HEAT PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes variable refrigerant flow split-system heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.02 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. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.
- C. 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.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

1.03 INFORMATIONAL SUBMITTALS

- A.
- B. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp. Refer to Section 230513, "Common Motor Requirements for HVAC Equipment."
- C. Training Certificates of Completion: Submit certificate from equipment manufacturer, indicating attendance and successful completion of manufacturer's training program for variable refrigerant flow systems installation and service. Training shall include manufacturer's preferred methods for assembling and insulating refrigerant piping and accessories.
- D. Submit system documentation for a fully engineered system, including shop drawings, and wiring and control diagrams, showing location of required manufactured system components, component model numbers and capacities, and size and location of all field-installed components, including piping, required expansion compensation devices, and wiring. Identify proposed deviations from system as shown in Contract Documents.
- E. Coordination Drawings: Plans, drawn to scale at 1/4 inch equals one foot, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. System installation, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to system layout.
 2. Suspended ceiling components.
 3. Structural members to which system components 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.
 7. Refer to Section 23 00 50, "Common Work Results for HVAC Systems for additional requirements.
- F. Roof Curb Data: For roof mounted equipment where combined weight of equipment unit and roof curb or rail exceeds 400 pounds, submit calculations from manufacturer for roof curbs proving compliance with the seismic requirements of the 2016 California Building Code, and ASCE 7-10. Manufacturer shall certify that roof curbs are suitable for use indicated on Drawings and in Specifications for the seismic design category indicated in structural Contract Documents. Calculations shall be stamped and signed by a State of California registered structural engineer.
- G. Field quality-control reports.
- H. Warranty: Sample of special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.05 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: Two set(s) of disposable filters for each air-handling unit indicated to accommodate disposable filters. One washable, permanent filters for each air handling unit designed to accommodate washable, permanent filters.

1.06 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/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. Variable Refrigerant Flow Split-System Heat Pump Installer Training: Installing contractor shall have completed training in installation and service of VRF system, by equipment manufacturer.
 1. Installing contractor shall obtain, at his own cost, equipment manufacturer's VRF system service tool, unless service tool is normally resident on controller specified for this Project.

1.07 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.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.02 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following, or equal:
 1. Carrier/Toshiba.
 2. Daikin.
 3. Mitsubishi.

2.03 INDOOR UNITS

- A. General:
 1. Galvanized steel casing.
 2. Ducted, ceiling-recessed, or in-room units per Drawings schedule. Available styles shall include:
 - a. Concealed (ducted) units:
 - 1) Horizontal/Vertical air handling unit for closet or above-ceiling installation.
 - 2) Ceiling concealed.
 - 3) Ceiling concealed, with high-static option.

3. Factory assembled and tested with factory wiring, piping, expansion valve, control circuit board, and fan motor. Units shall have, as a minimum, the following functions:
 - a. Self-diagnostic function.
 - b. Auto restart function.
 - c. Auto changeover function.
 - d. Emergency operation function.
 - e. 3-minute time delay shall provide minimum 3 minute run time for cooling and heating.
 4. Indoor unit and refrigerant pipes shall be charged with dehydrated air prior to shipment from the factory.
 5. The indoor units shall be equipped with a return air thermistor.
- B. Unit Cabinet:
1. The cabinet shall be insulated with foamed polystyrene and polyethylene insulation.
- C. Fan:
1. The fan shall be direct-drive type, statically and dynamically balanced impeller with multiple high and low fan speeds. Auto fan setting shall automatically adjust fan speed.
 2. The fan motor shall be thermally protected.
 3. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
 4. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 05 13, "Common Motor Requirements for HVAC Equipment."
 5. All units shall be provided with a condensate drain pan below the coil. Drain pans shall have primary and overflow drains.
- D. Coil:
1. Coils shall be aluminum fins bonded to internally grooved copper tubes. Fins shall have corrosion-resistant coating.
 2. The coils shall be pressure tested at the factory.
 3. Unit shall be provided with ball-type refrigerant service valves at each refrigerant piping connection.
 4. A condensate pan and drain connections shall be provided under the coil. Provide overflow cutoff switch to disable unit during overflow condition.
- E. Filters:
1. Concealed (ducted) units mixing boxes shall include filter rack designed to accommodate disposable filters, as specified in Drawings schedules and in Section 234100, "Particulate Air Filtration."
- F. Controls:
1. Units shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

2. Operating modes shall include Auto Changeover (heat recovery systems only), Heating, Cooling, Dry, and Fan Only.
3. Units shall be compatible with a BMS system via optional LonWorks or BACnet gateways.

2.04 OUTDOOR CONDENSING UNITS

A. General:

1. Condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves (when required by manufacturer), 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator and regulator.
2. The following safety devices shall be included as part of the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, over- and under-current protection, phase failure and phase reversal protection, fusible plug or pressure relief valve, and crankcase heater.
3. The system will automatically restart operation after a power failure without loss of settings.
4. The condensing units shall be modular in design and allow for side-by-side installation with minimum spacing. Provide kit for field piping between connected condensing units. Refer to Drawings schedules and diagrams for connected units.
5. To ensure the liquid refrigerant does not flash when supplying to indoor units, the circuit shall be provided with a sub-cooling feature.
6. Oil recovery cycle shall be automatic occurring 2 hours after start of operation, and thereafter every 8 hours of operation. Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.
7. The condensing unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

B. Unit Cabinet:

1. The condensing unit cabinet shall be weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel or powder coat finish.

C. Fan:

1. The condensing unit shall consist of one or more direct-drive, vertical discharge propeller fans with blades constructed of thermoplastic polymer material.
2. The condensing unit fan motor shall be variable-speed digitally commutating (DC) type. Fan motor dipswitch shall allow increase of external static pressure setting.
3. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted on vibration isolators.
4. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. Condenser Coil:

1. Coils shall be aluminum fins bonded to internally grooved copper tubes. Fins shall have corrosion-resistant coating.
 2. The coils shall be pressure tested at the factory.
 3. Unit shall be provided with ball-type refrigerant service valves at each refrigerant piping connection.
 4. Condensing unit cabinet shall be provided with metal coil guard.
- E. Compressor:
1. The scroll compressors shall be variable speed pulse-width inverter (PVM inverter) controlled type, hermetically sealed, which shall vary the compressor speed to follow fluctuations in total cooling and heating load, determined by the suction gas pressure as measured in the condensing unit.
 - a. The inverter driven compressor motor in each condensing unit shall be the reluctance DC (digitally commutating) type.
 2. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
 3. Oil separators shall be provided as part of the compressor module together with an intelligent oil management system.
 4. The compressor shall be isolated to avoid the transmission of vibration.
 5. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity.
 6. Multiple compressor operation sequencing: When multiple condenser modules are combined, operation hours of each compressor shall be balanced by means of a duty cycling function, enabling sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.
 7. Refrigerant shall be R410a.

2.05 REFRIGERANT PIPING

- A. All refrigerant lines shall be individually insulated between the condensing units and indoor units. Refer to Section 23 07 19, HVAC Piping Insulation, for insulation requirements.
- B. For interconnecting piping between outdoor and indoor equipment, refer to Section 232300, "Refrigerant Piping."

2.06 SYSTEM CONTROLS

- A. General: The controls network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to a Building Management Systems via BACnet® and/or LonWorks®.
- B. For additional information, Refer Section 23 09 23, Direct Digital Control System for HVAC.
- C. Programmable Local Remote Controller: The programmable local remote controller shall be capable of controlling a minimum of 16 indoor units serving a single zone, and of operation with or without a central controller. Controller shall have the following minimum functions:
 1. On/Off.

2. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
 3. Temperature setting.
 4. Fan speed setting.
 5. Air swing settings.
 6. Room temperature and humidity display.
 7. Occupancy sensor capable.
 8. Schedule operations.
 9. Allow/Prohibit local remote control functions.
 10. Unit level error code display.
 11. Test run.
 12. Set temperature range limit.
 13. Override of scheduled functions for indoor unit groups.
 14. Lock out of On/Off, Mode, Set Temp., Hold-button, and Air Direction.
- D. Limited Function Local Remote Controller: The limited function local remote controller shall be capable of controlling a minimum of 16 indoor units serving a single zone. Controller shall have the following minimum functions:
1. On/Off.
 2. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
 3. Temperature setting.
 4. Fan speed setting.
 5. Air swing settings.
 6. Allow/Prohibit local remote control functions.
 7. Indoor Unit intake temperature display.
 8. Unit level error code display.
 9. Test run.
 10. Set temperature range limit.
- E. Centralized Controller: The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units, or all indoor units. (cool, heat, auto, dry, and fan)The central controller shall be able to enable or disable operation of local remote controllers via a PC. Controller shall have the following minimum functions:
1. On/Off.
 2. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
 3. Temperature setting.
 4. Fan speed setting.
 5. Air swing settings.
 6. Room temperature display.
 7. Schedule operations.

8. Morning warm-up/cool-down.
 9. Night setback setting.
 10. Allow/Prohibit local remote control functions.
 11. Unit level error code display.
 12. External input/output.
 13. PC data back-up.
- F. BACnet® and/or LonWorks® Gateway: Gateway to allow connection to Energy Management Systems shall allow changes to the following, as a minimum:
1. On/Off.
 2. Temperature setting.
 3. Alarm.
 4. Operating mode.
 5. Fan speed setting.
 6. Allow/Prohibit local remote control functions.
 7. High/Low limit setback temperature (heat recovery systems only).
 8. Air direction/swing settings.
- G. Web browser: The controls network shall allow multiple individual users to monitor and control user defined zones via a network PC web browser.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The system shall be installed by a factory-trained and certified contractor, in strict conformance with unit manufacturer's instructions.
- B. Install units level and plumb.
- C. Install evaporator-fan components as detailed on Drawings.
- D. Install indoor heat recovery controllers as detailed on Drawings. Install condensate drain pan piping and run to nearest code-compliant receptacle, or as indicated on Drawings.
- E. Install roof- mounted condensing units as detailed on Drawings. Connected condensing units shall allow space for coil cleaning and other required maintenance tasks.
- F. Install seismic restraints as required by applicable codes. Refer to Section 230548, "Vibration and Seismic Controls for HVAC Piping and Equipment," for delegated design requirements for seismic restraints.
- G. Install and connect refrigerant piping as detailed in unit manufacturers' literature. Install piping to allow access to unit. Install ball-type refrigerant service valves in refrigerant piping at downstream connections of indoor heat recovery units. Refer to Section 232300, "Refrigerant Piping."
- H. Insulate all refrigerant piping, including headers, branches, and other components as detailed in unit manufacturers' literature. Refer to Section 230719 "HVAC Piping Insulation."

- I. Install air filters at each indoor unit. Install washable, permanent filters at indoor units designed to accept washable, permanent filters. Refer to Drawings schedule, and Section 234100, "Particulate Air Filtration," for filter requirements for ducted, above-ceiling units incorporating mixing boxes.
- J. Install cooling coil condensate primary drain pan piping, and run to nearest code-compliant receptacle, or as indicated on Drawings. Install secondary drain pan for units installed over permanent and suspended-tile ceilings. Install secondary drain pan piping and terminate 1/2 inch below ceiling, with escutcheon, in a readily visible location or as shown on Drawings.

3.02 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.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.03 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.

3.04 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.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Provide minimum 2 hours training.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. Electrical General Provisions and Requirements for electrical work.
 - 3. Division-1; General Requirements; General Conditions.
- B. Organization of the Specifications into Divisions, Sections and Articles, and arrangement of Drawings shall not control the Contractor in dividing the Contract Work among Sub-Contractors or in establishing the extent of work to be performed by any trade.

1.02 GENERAL SUMMARY OF ELECTRICAL WORK

- A. The Specifications and Drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.
- B. Refer to the Drawings and Shop Drawings of other trades for additional details, which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.
- C. Before submitting a bid, the Contractor shall become familiar with all features of the Building Drawings and Site Drawings, which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.
- D. If there are omissions or conflicts between the Drawings and Specifications, clarify these points with the District's Representative before submitting bid and before commencing work.
- E. Provide work and material in conformance with the Manufacturer's published recommendations for respective equipment and systems.

1.03 LOCATIONS OF EQUIPMENT

- A. The Drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.
- B. Where outlets are placed on a wall, locate symmetrically with respect to each other, furniture, cabinets, and other features or finishes on the wall.

- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without cost to the Contract, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.
- D. Lighting fixtures in mechanical spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and ductwork is installed; then install lights in a location to provide best lighting.
- E. Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.
- F. The location of the existing utilities, building, equipment and conduit shown on the Drawings is approximate. Verify exact locations and routing of existing systems by potholing all trench routes prior to digging the trench. Pothole at least 100 feet ahead of the actual trenching to allow space to alter the new conduit routing to accommodate existing conditions.
- G. Underground Detection Services Existing Utility Structures
 1. Detection/location services shall be provided utilizing the latest detection equipment available. Services shall be performed by a company regularly engaged in the business of existing Underground Utility Structure Detection for the past 5-years.
 2. Prior to excavation and prior to directional boring the following work shall be performed:
 - a. Contractor to mark excavating and trenching/directional boring locations and indicate width and depth.
 - b. Locate, by way of vertical and horizontal control dimensions, existing subgrade petroleum product pipes, process piping, conduits, sewer, water, gas, storm drain, electrical, telephone, and irrigation lines in the affected areas of Contract Construction Work.
 - c. Arrange and meet with the District's Representative to review existing underground conditions.
 - d. The proposed route of each excavation shall be continuously surveyed along the entire excavation path using Ground-Penetrating Radar (GPR) operating from the surface grade. The GPR shall detect and map existing underground metal and non-metal, private and public utility lines, pipes, conduits, conductors, etc. The GPR shall identify the horizontal and vertical location of existing underground conditions located at a depth of up to 3-meters below finish grade and located with a vertical and horizontal accuracy within ± 12 -inches of actual condition. The Contractor shall add this information to the existing Conditions Site Plan.
 3. Exercise extreme caution in directional boring, excavating and trenching on this site to avoid existing underground utilities and structures, and to prevent hazard to personnel and/or damage to existing underground utilities or structures. The Contract Documents, Drawings and Specifications do not include necessary components for construction safety, which is the responsibility of the Contractor.
 4. Repair/replace, without additional cost to the Contract, and to the satisfaction of the District any existing work damaged that was identified in the Record Drawings provided; Identified by the District's Representative; Identified by the Underground Detection

Services performed; or any existing work damaged as a result of failure to comply with all the Referenced Requirements.

5. The Contractor shall contact Common Ground Alliance (CGA) telephone #811 "Know What's Below-Call Before You Dig" and Underground Service Alert (USA), not less than 72-hours prior to excavation. Contractor shall not excavate until verification has been received from CGA and USA that existing underground utilities serving the site have been located, identified, and marked.
- H. The locations of existing underground utilities, where shown on Drawings, are shown diagrammatically and have not been independently verified by the District, District's Representative, and the Architect/Engineer. The District, the District's Representative, and the District's Architect/Engineer are not responsible for the location of underground utilities or structures, whether or not shown or detailed and installed under this or any other Contracts. The Contractor shall identify each existing utility line prior to excavation and mark the locations on the ground of each existing utility line.

1.04 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

Provide electrical work, materials, and control components required for proper operation of the air conditioning, heating and plumbing systems as indicated on the Electrical, Mechanical, and Plumbing Contract Documents and specified herein.

1.05 PERMITS

Take out and pay for all Required Permits, Inspections and Examinations without additional cost to the District.

1.06 QUALITY ASSURANCE

- A. Work and Materials shall be in full accordance with the latest Rules and Regulations. The following publications shall be included in the Contract Documents Requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the Requirements describing the more restrictive provisions shall become the applicable Contract definition:
 1. California Code of Regulations Title 24.
 2. California Part 3 "California Electrical Code" CEC, Title 24 and Title 8 "Division of Industrial Safety".
 3. California Building Code – CBC.
 4. California Fire Code – CFC
 5. The National Electrical Code – NEC/NFPA 70.
 6. International Building Code – IBC.
 7. National Fire Protection Agency – NFPA.
 8. National Fire Alarm Code – NFAC/NFPA 72.
 9. Underwriter's Laboratory – UL.
 10. Other applicable State and Local Government Agencies Laws and Regulations.

11. Electrical Installation Standards National Electrical Contractors Association (NECA) and National Electrical Installation Standards (NEIS):
 - a. NECA/NEIS-1: Standard of Practices for Good Workmanship in Electrical Contracting
 - b. NECA/NEIS-101: Standard for Installing Steel Conduit (Rigid, IMC, etc.)
 - c. NECA/NEIS-104: Recommended Practice for Installing Aluminum Building Wire and Cable (ANSI)
 - d. NECA/NEIS-105: Standard for Installing Metal Cable Tray Systems (ANSI)
 - e. NECA/NEIS-111: Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)
 - f. NECA/NEIS-230: Recommended Practice for Installing Motors
 - g. NECA/FOA-301: Standards for Installing and Testing Fiber Optic Cables
 - h. NECA/NEIS-305: Standard for Fire Alarm System Job Practice
 - i. NECA/NEIS-331: Standards for Installing Building and Service Entrance Grounding and Bonding.
 - j. NECA/NEIS-400: Standard for Installing and Maintaining Switchboards
 - k. NECA/NEIS-402: Recommended Practice for Installing and Maintaining Motor Control Centers
 - l. NEIS/NECA and EGSA-404: Recommended Practice for installing Generator Sets
 - m. NECA/NEIS-405: Recommended Practices for installing and Commissioning Interconnected Generation Systems
 - n. NECA/NEIS-407: Recommended Practice for Installing Panelboards
 - o. NECA/NEIS-408: Standards for Installing and Maintaining Busways (ANSI)
 - p. NECA/NEIS-409: Recommended Practice for Installing and Maintaining Dry-Type Transformers
 - q. NEIS/NECA and IESNA-500: Recommended Practice for installing indoor Commercial Lighting Systems
 - r. NEIS/NECA and IESNA-501: Recommended Practice for Installing Exterior Lighting Systems
 - s. NEIS and IESNA-502: Recommended Practice for Installing Industrial Lighting Systems
 - t. NECA/BICSI-568: Standards for Installing Commercial Building Telecommunications System
 - u. NECA/NEIS-600: Standard for Installing and Maintaining Medium-Voltage Cable (ANSI)
- B. All Material and Equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized Testing Laboratories, where such listings are available. Comply with all Installation Requirements and restrictions pertaining to such listings.
- C. Work and Material shown on the Drawings and in the Specifications are new and included in the Contract unless specifically indicated as existing or N.I.C. (not in Contract).
- D. Keep a copy of all applicable Codes and Standards available at the job site at all times for reference while performing work under this Contract. Nothing in Plans or Specifications shall be construed to permit work not conforming to the most stringent of Building Codes.

- E. Where a conflict or variation occurs between applicable Codes, Standards and/or the Contract Documents, the provisions of the most restrictive provision shall become the Requirement of the Contract Documents.

1.07 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General

1. Review of Contractor's submittals is for General Conformance with the design concept of the Project and General Compliance with the information given in the Contract Documents. Any action shown is subject to the Requirements of the Plans and Specifications. Contractor is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.
2. The Contractor shall review each submittal in detail for compliance with the Requirements of the Contract Documents prior to submittal. The Contractor shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS". The Contractor shall clearly and specifically identify each individual proposed substitution, substitution of equal or proposed deviation from the Requirements of the Contract Documents with a statement "THIS ITEM IS A SUBSTITUTION".

The burden of research, preparation of calculations and the furnishing of adequate and complete Shop Drawings information to demonstrate the suitability of Contractor's proposed substitutions and suitability of proposed deviations from the Contract Documents is the responsibility of the Contractor.
3. Departure from the submittal procedure will result in resubmittals and delays. Failure of the Contractor to comply with the Submittal Requirements shall render void any acceptance or any approval of the proposed variation. The Contractor shall then be required to provide the equipment or method without variation from the Contract Documents and without additional cost to the Contract.
4. The Contractor at no additional cost or delays to the Contract shall remove any work, material and correct any deficiencies resulting from deviations from the Requirements of the Contract Documents not approved in advance by the District prior to commencement of work.
5. Shop Drawings submitted by the Contractor, which are not specifically required for submittal by the Contract Documents, or Contractor Shop Drawings previously reviewed and resubmitted without a written resubmittal request to the Contractor, will not be reviewed, considered, or commented on. The respective Shop Drawing submittal / resubmittal will not be returned to the Contractor and will be destroyed without comment or response to the Contractor. The respective submittal shall be considered null and void as being not in compliance with the Requirements of the Contract Documents.
6. Refer to Division-1 for Additional Requirements.

B. Material Lists and Shop Drawings

1. Submit material list and Equipment Manufacturers for review within 35 days of award of Contract. Give name of Manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one Manufacturer for any one item of equipment, or listing items "as specified", without both make and model or type designation, is not acceptable. Shop Drawings shall not be submitted before review completion of Manufacturers list. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.
2. After completion of review of the Material and Equipment Manufacturers list, submit Shop Drawings for review. Shop Drawings shall be submitted in completed bound groups of materials (i.e., all lighting fixtures or all switchgear, etc.). The Contractor shall verify dimensions of equipment and be satisfied as to fit and that they comply with all Code Requirements relating to clear working space about electrical equipment prior to submitting Shop Drawings for review. Submittals, which are intended to be reviewed as substitution or departure from the Contract Documents, must be specifically noted as such. The Requirements of the Contract Documents shall prevail regardless of the acceptance of the submittal.
3. Shop Drawings shall include catalog data sheets, instruction manuals, Dimensioned Plans, elevations, details, wiring diagrams, and descriptive literature of component parts where applicable. Structural calculations and mounting details, signed by a Structural Engineer registered by the State of California, shall be submitted for all equipment weighing over 400-pounds, and shall be in compliance with Title 21 of the California Code of Regulations.
4. Each Shop Drawing item shall be identified with the Specification Section and paragraph numbers, lighting fixture types and Drawing sheet numbers; the specific Shop Drawing is intended to represent. Shop Drawings 11-inches by 17-inches or smaller in size shall be bound in three ring binders. Divider tabs shall be provided in the three ring binders identifying and separating each separate Shop Drawing submittal item. Shop Drawings larger than 11-inches by 17-inches, Shop Drawing pages/sheets submittals shall be sequentially numbered with unique alphanumeric numbering system to facilitate correspondence referencing identification of individual sheets.
5. The time required to review and comment on the Contractor's submittals will not be less than 14 calendar days, after receipt of the submittals at the office of FBA Engineering. The review of Contractor submittals and return to Contractor of submittals with review comments will occur in a timely manner conditioned upon the Contractor complying with all of the following:
 - a. The submittals contain complete and accurate information, complying with the Requirements of the Contract Documents.
 - b. Contractor's submittals are each marked with Contractor's approval "stamp", and with Contractor signatures.
 - c. The submittals are received in accordance with a written, Shop Drawing submittal schedule for each submittal. The Contractor distributes the schedule not less than 35-calendar days in advance of the Shop Drawing submittals, and the schedule identifies the calendar dates, the Contractor will deliver the various submittals for review.

6. Shop Drawings shall include the Manufacturers projected days for shipment from the factory of completed equipment, after the Contractor releases the equipment for production. It shall be the responsibility of the Contractor to insure that all material and equipment is ordered in time to provide an orderly progression of the work. The Contractor shall notify the District's Representative of any changes in delivery, which would affect the Project completion date.
7. Submittal Identification
 - a. Each submittal shall be dated: with submittal transmission date; sequentially numbered and titled with submittal contents identification and applicable Specification/Drawing references (*i.e., Submittal dated: 5/12/98 Submittal #4 Contents: Branch Circuit Panelboards Sheet #E5.1 and Transformers Specification Section 260501 Paragraph 2.11, etc.*).
 - b. Each resubmittal shall be dated: with original submittal date and resubmittal transmission dates; sequentially numbered with original submittal number and sequential resubmittal revision number and titled with submittal contents identification and applicable Specifications/Drawing references (*i.e., Original Submittal Date: 5/12/98 Resubmittal Date: 10/9/98 Original Submittal #4 Resubmittal Revision R2 Contents: Transformer Resubmittal Specification Section – 260501 Paragraph 2.11, etc.*).
 - c. Contractor shall provide a written response narrative with each resubmittal. Describe each response-action, resubmittal addition, change and deletion. Correspond to each response to A/E specific review comment.
- C. The Contractor shall be responsible for incidental, direct and indirect costs resulting from the Contractor's substitution of; or changes to; the specified Contract Materials and Work.
- D. The Contractor shall pay, upon request by the District's Representative, a fee for the District's Representative time involved in the review of substitution submittals and design changes resulting from the Contractor's requested substitutions. The fee shall be not less than \$125.00 per hour but, in no case, less than stated in Division-1, whichever is greater.
- E. Maintenance and Operating Manuals
 1. The Contractor shall furnish three copies of type-written Maintenance and Operating Manuals for all electrical equipment, fire alarm equipment, sound system equipment, etc., to the District.
 2. Instruct the District's Personnel in correct operation of all equipment at completion of Project. Provide the quantity and duration of instruction class as specified; but in no case less than two 4-hour durations separate instruction classes for each individual equipment group furnished as part of the Contract. Instruction classes shall be presented by Manufacturer's Authorized Field Service Engineer at the Project Site. Instruction class size shall be at the District's discretion, not less than one or more than fifteen students shall attend each instruction session. Submit fifteen written outline copies of the proposed instruction class curriculum, 14-days prior to the class-scheduled dates.
 3. Maintenance and Operating Manuals shall be bound in three ring, hard-cover, plastic binders with table of contents. Manuals shall be delivered to the District's Representative, with an itemized receipt.

- F. Portable or Detachable Parts: The Contractor shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of Contract Work. These parts shall then be delivered to the District's Representative with an itemized receipt.
- G. Record Drawings (Additional Requirements)
 - 1. Provide and maintain in good order a complete set of Electrical Contract "Record" prints. Changes to the Contract to be clearly recorded on this set of prints. At the end of the Project, transfer all changes to one set of transparencies to be delivered unfolded to the District's Representative.
 - 2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. If any necessary dimensions are omitted from the Record Drawings, the Contractor shall, at the Contractor's own expense, do all excavation required to expose the buried work and to establish the correct locations.
 - 3. The Contractor shall keep the "Record" prints up to date and current with all work performed.
 - 4. Refer to Division-1 for Additional Requirements.

1.8 CLEANING EQUIPMENT, MATERIALS, PREMISES

All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.9 JOB CONDITIONS - PROTECTION

Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. Provide for the safety and good condition of all the work until final acceptance of the work by the District and replace all damaged or defective work, materials, and equipment before requesting final acceptance.

1.10 EXCAVATION, CUTTING, BACKFILL AND PATCHING ADDITIONAL REQUIREMENTS

- A. General
 - 1. Perform excavation, cutting, backfill, core drilling, directional boring, and patching of the construction work required for the proper installation of the electrical work.
 - 2. Patching shall be of the same material, thickness, workmanship, and finish as existing and accurately match-surrounding work to the satisfaction of the District's Representative.
 - 3. Prior to penetrating, coring, drilling or cutting existing building elements, concrete and/or masonry, provide imaging equipment examinations of each specific location. The imaging process shall identify existing internal embedded components and locations, including structural elements/anchors, conduit, and piping that are present. Do not penetrate or damage the existing internal embedded elements.

Imaging shall employ one of the following, with GPR methodology preferred:

- a. Non-invasive imaging employing high frequency, Ground Penetrating Radar (GPR), single side echo reflection technology.
- b. Non-invasive imaging employing x-ray radiography, through-and-through imaging technology.

B. Excavation Temporary Cover

1. Excavations for Contract Work occurring in streets, vehicular drive areas, parking lots, sidewalks; any paved surface; or any area accessible to the public; provide temporary steel plating and shoring support for the plates, to completely cover the excavations under one or more of the following conditions:
 - a. Excavation shall not remain "open" for more than 4-calendar days; provide temporary plating.
 - b. Excavation shall not be "open" over weekends (Saturday, Sunday) or Holidays; provide temporary plating.
2. The temporary plating shall be a minimum of 0.75-inch thickness steel, but in no case shall the thickness be less than required to support AASHO-H20 traffic loading.
3. Provide a minimum of two 100% open lane(s) (12-foot lane width) for vehicular traffic at all times during construction, for vehicle access to all areas.

1.11 IDENTIFICATION

A. Equipment Nameplates

1. Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, push-button control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.
2. Provide nameplate label on electrical service entrance equipment describing available short circuit information calculated by the Contractor, including:
 - a. Calculation date, month-day-year.
 - b. Calculate maximum available short circuit fault current.
 - c. Description of parameters and changes affecting the Requirements for recalculation of the fault current information.
3. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electric-Arc-Flash" warning signs. The signs shall explain a hazard to Personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct Personnel to wear the correct Protective Equipment/clothing (PPE) when working "Live", or operating "Live" electrical equipment and circuits.
4. Nameplates shall be engraved laminated phenolic. Shop Drawings with dimensions and format shall be submitted before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.

5. Provide black-on-white laminated plastic nameplates engraved in minimum ¼-inch high letters to correspond with the designations on the Drawings. Provide other or additional information on nameplates where indicated.
- B. Plates: All cover and device plates shall be furnished with engraved or etched designations under any one of the following conditions (minimum character size not less than 0.188 inch. Engraving shall indicate circuits and equipment controlled or connected):
1. More than two devices under a common coverplate.
 2. Lock switches.
 3. Pilot switches.
 4. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
 5. Manual motor starting switches.
 6. Where so indicated on the Drawings.
 7. As required on all control circuit switches, such as heater controls, motor controls, etc.
 8. Receptacles other than standard 15 amp 120 volt duplex receptacles; shall indicate circuit voltage, ampere, phase and source circuit number.
 9. Where outlets or switches are connected to emergency power circuit; provide panel-board and circuit number engraved on plate.
 10. Low voltage and signal system outlets.
- C. For equipment and access doors or gates to equipment containing or operating on circuits of more than 100 volts AC or DC nominal. Provide red-on-white laminated warning signs engraved in ½-inch high letters to read: "DANGER - 480 (*or applicable voltage*) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY".
- D. Wire and Cable Identification
1. Provide identification on individual wire and cable including signal systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and controls circuit.
 2. Permanent identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.
 - a. Individual wire and cable larger than #6AWG or 0.25-inch diameter shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alphanumeric characters, character height 0.25 inch. Attach identification tags with plastic "tie" wraps, minimum of two for each tag. As manufactured by Almetek Industries-"EZTAG" Series; or TECH Products - "EVERLAST" Series.
 - b. Individual wire and cable #6AWG and smaller or smaller than 0.25 inch diameter, shall be provided with water and oil resistant, flexible, self-laminating pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification. As manufactured by Brady Identification; or 3M; or Panduit.

- c. Each identification tag location shall indicate the following information: circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).
- 3. Install permanent identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.
- E. Cardholders and cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuit, area, and connected load.
- F. Junction and pull boxes shall have covers stenciled with box number when shown on the Drawings, or circuit numbers according to panel schedule. Data shall be lettered in a conspicuous manner with a color contrasting to finish.

1.12 TESTING

- A. The Contractor shall obtain an independent Testing Laboratory, provide all instrumentation and perform tests on the electrical system and equipment as hereinafter described and further directed by the District's Representative. The test shall be performed after the completion of all electrical systems included in the Contract Scope of Work. All tests shall be recorded and documented and submitted to the District's Representative for review.
 - 1. All Equipment and Personnel required for set-up and testing shall be provided by the Contractor.
- B. Test for Phase to Ground and Neutral Condition:
 - 1. Open main service disconnects.
 - 2. Isolate the system neutral from ground by removing the neutral disconnects link located in the service switchboard.
 - 3. Close all submain disconnects.
 - 4. Close all branch feeder circuit breakers.
 - 5. Turn all switches to "on" position, unplug all portable equipment from outlet receptacles.
 - 6. Measure the resistance of each phase to ground and phase to neutral. A properly calibrated "megger" type test instrument shall be used. The test voltage shall be a nominal 500 volts.
 - 7. Record all readings after 1-minute duration and document into a complete report.
 - 8. Isolating Grounds: In the event that low resistance ground neutral connections are found in the system, they shall be isolated and located by testing each circuit individually as outlined above. Make proper corrections to restore the resistance values to an acceptable value.
- C. Method of obtaining ground resistance shall be in accordance with the latest edition of the James G. Biddle (Plymouth Meeting, Pennsylvania) manual published on this subject.
 - 1. Perform "fall-of-potential" three point tests on the main grounding electrode of system per IEEE Standard No. 81, Section 8.2.1.5. when suitable locations for test rods are not available, a low resistance dead earth or reference ground shall be utilized.

2. Perform the two point method test per IEEE Standard No. 81, Section 8.2.1.1, to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- D. The testing, calibrating and setting of all ground and ground fault equipment, circuit breakers, circuit device protection relays, and meters adjustable settings shall be by an independent Testing Laboratory. Set as recommended by the respective Manufacturer and Coordination Study so as to be coordinated with other protection devices within the electrical design. Bound and tabulated copies of the test and settings shall be sent to the District's Representative.
- E. Ampere and Voltage Measurements
1. Measure and record ampere and line voltage measurements under full load on all panel feeders, switchboard, and switchgear feeders, motor control centers and motor circuits provided in the Contract. Record measurements at the equipment tested and submit to the District's Representative for review.
 2. Ampere voltage readings shall be:
 - a. Phase A-B, A-C and B-C.
 - b. Phase A-Neutral, B-Neutral and C-Neutral.
 3. The ampere and voltage readings shall be not less than 20-minutes duration for each test. Record and submit the measured minimum, maximum and 20-minute average for each ampere and voltage value and test location. Voltage and ampere measurements shall occur at the connected load end of each respective feeder, not at the source of supply end of each feeder.
 4. Test equipment shall be accurate within plus or minus 1%.
 5. Branch circuit devices 40 amp or less and motor loads ten horsepower or smaller are excluded from Ampere and Voltage Testing Requirement.
 6. If, in the opinion of the District's Representative, the voltages and regulations are not met within acceptable limits, make arrangements with the serving utility for proper electrical service. Retest feeder line voltages, and submit to District's Representative for review, after the Utility Company has completed corrective actions. Reset "voltage taps" on transformers provided or modified as part of the Contract Work, to adjust line voltages to within acceptable values, as directed by the District's Representative.
- F. The Contractor shall complete the following work before any electrical equipment is energized.
1. All equipment shall be permanently anchored.
 2. All bus connections and conductor/wire connections shall be tightened per Manufacturer's instructions and witnessed by the District's Representative.
 3. All ground connections shall be completed and identified. Perform and successfully complete all required megger and ground resistance tests.
 4. Feeders shall be connected and identified.
 5. The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other abrasive's over spray removed and equipment vacuumed clean. The District's Representative shall observe all interiors before covers are installed.

6. All wall, ceiling, and floor work and painting shall be completed within areas containing electrical equipment prior to installation of equipment. The equipment indoor rooms and spaces shall be weather-tight and weather protected from environmental incursions.
7. All doors to electrical equipment rooms shall be provided with locks in order to restrict access to energized equipment.
8. Electrical spaces and rooms shall not be used as storage rooms after power is energized.
9. Outdoor electrical equipment enclosures and housings shall be weather protected.
10. The electrical system time current coordination and Arc-Fault study shall be complete for circuit breakers, ground relays sets, and circuit relay sets, fuses; set-up, tested and calibrated accordingly.

1.13 COMMISSIONING - CX

A. General

1. The Commissioning shall verify the electrical systems for the term of the Contract, by observation; and by calibration; and by testing. The Commissioning shall ensure the electrical systems perform interactively and correctly, according to the Contract and Operational Requirements.
2. Commissioning shall provide startup, testing and documented confirmation of the Contract Constructed Systems, materials and work, functions in compliance within the criteria set forth in the Contract Documents to the satisfaction of the District's needs. The Commissioning Scope shall encompass each system identified as requiring "Commissioning" by the Contract Documents, including but not limited to:
 - a. Electrical circuits' protection, short circuit, overcurrent, and ground fault devices.
 - b. Electrical circuits monitoring and metering.
 - c. Light fixtures, lamps and ballasts.
 - d. Lighting control devices, equipment and lighting control systems.
 - e. Standby and emergency electric power supply equipment and systems.
 - f. Fire alarm, equipment, devices and fire alarm systems.
 - g. Additional systems described in the Contract Documents.
3. Commissioning process shall review all of the Shop Drawing submittals, including:
 - a. Controls, Operation and Maintenance Requirements.
 - b. Facility performance testing compliance.
 - c. Project Contract Requirements compliance.
 - d. Compliance with basis for design and operational descriptions provided in the Contract.
4. Commissioning shall be the process of ensuring all the systems described in the Contract Documents comply with the Contract Document design; all systems are installed properly; all systems are functional, tested and capable of being operated and maintained to perform within the Contract Requirements and design intent.
5. Functional setup, recalibration, correcting deficiencies, retesting and the associated costs, for system(s) that fail Commissioning, shall be the responsibility of the Contractor. The Contractor shall include all Commissioning costs in the Contract Scope of Work.

6. Complete all Commissioning functions prior to the occupancy of the facility by the District, unless directed otherwise by the District's Representative.
7. Submit six copies of Commissioning Documentation to District's Representative.
8. Commissioning unless specifically indicated otherwise, shall be performed by Factory-Trained Technician(s) Authorized and Certified by the Manufacturers of the respective equipment/systems. Where specifically indicated, Commissioning shall be performed by Independent Test Lab.

B. Commissioning Procedures

1. Prepare a Commissioning Matrix identifying components and systems included in the Commissioning Scope; the status; actions completed and actions to be completed.
2. Verify Contractor compliance with Contract Document Requirements Manufacturer's recommendations and approved Shop Drawings.
3. Perform startup, functional tests, reports, and document results.
4. Evaluate and document the setup parameters, software, operating condition and performance of each system at the time of functional test completion. Document and record each performance parameter and condition, in the Commissioning Report.
5. Schedule testing and prepare descriptions of testing.
6. Describe measures performed to correct deficiencies.
7. Verify that instructions to District's Representatives, Operations and Maintenance Manuals comply with Contract Documents.
8. Prepare warranty matrix identifying the start dates, expiration dates, routine preventative maintenance dates and the District's responsibility for performing preventative maintenance and keeping logs for each maintenance function and warranty claims.
9. Confirm completion of all punch list items that have been acceptably accomplished and a list of what has not been acceptably completed.
10. Describe uncorrected deficiencies accepted by the District.

C. Commissioning Phasing

The Commissioning Phases of work shall include the following activities:

1. SDQ – Shop Drawing Qualification shall verify complete and correct Shop Drawings have been submitted.
2. IQ – The Installation Qualification of Contract Work shall verify systems are correctly and properly installed.
3. OQ – Verify systems interfaces and software are correctly and properly operational.
4. ITM – Verify the Contract Inspection, Testing and Procedures for Maintenance are complete.
5. PQ – Performance Qualification complete the functional performance testing to validate each building system.

1.14 POWER OUTAGES

- A. All electrical services in all occupied facilities of the Contract Work are to remain operational during the entire Contract period. Any interruption of the electrical services for the performance of this work shall be at the convenience of the District and performed only after consultation with the District's Representative. Work involving circuit outages shall be only at such a time and of such a duration as approved in writing. Work involving circuit outages for the work required to connect new equipment and disconnect existing equipment shall be performed at the convenience of the District.
- B. Contract Work involving outages or disruption of normal function in electrical power systems, telephone/communication systems, fire alarms, shall be performed during the following time periods. The Contract Work shall be phased to limit outages in the respective systems to the stated periods:
 - 1. 11:30 p.m. Friday to 11:30 p.m. Sunday of the same weekend. Work shall occur on multiple weekend periods if a single weekend is not sufficient time to complete the work.
 - 2. The Contract Work involving outages shall be phased in multiple work time units, to comply with the permitted outage limitations.
- C. Work involving system outages to the building fire alarm system shall be performed only after consultation with the District and shall be only at such a time and of such duration as approved in writing. Contractor shall provide continuous "Fire-Watch" during fire alarm system outages and comply with AHJ "Fire-Watch" Requirements.
- D. Provide overtime work; double shift work; night time work; Saturday, Sunday, and holiday work to meet outages schedule.
- E. Provide temporary electrical power to meet the Requirements of this Article.
- F. Any added costs to Contractor due to necessity of complying with this Article shall be included in the Contract Scope of Work.
- G. When electrical work involving power disruptions to existing areas is initiated, the work shall proceed on a continuous basis without stopping until electric power is restored to the affected areas.
- H. The Contractor shall request in writing to the District's Representative a minimum of 3-weeks in advance, for any proposed electrical outage.

1.15 TEMPORARY ELECTRICAL POWER

- A. Provide temporary electrical power if work requiring power outages cannot be completed in time permitted and approved by the District's Representative.
- B. Temporary electrical power shall be a standby diesel engine generators. Voltage, Frequency, Regulation, etc. shall be equal to that of normal utility source. Exhaust system shall have a critical silencing muffler. Generator voltage shall match the existing secondary voltage required at the site. The Contractor shall furnish all necessary cables, switches, etc., to make all required connections to existing panels, feeders, etc. Generator shall be sized to adequately carry the demand load. If record of demand load is not available, size generator to match corresponding transformer, maximum capacity circuit as directed by the District's Representative.

- C. After completion of required usage of the temporary generators, prior to completion of the project, the Contractor shall remove the generators. All temporary cables, switches, etc. shall be removed and all permanent equipment left in satisfactory condition.
- D. Each generator shall be housed in security type sound attenuated housing to prevent access by unauthorized Personnel. Temporary power cables, connections, etc. shall be protected from unauthorized personnel.
- E. The Contractor shall be responsible for complete operation of the generator including Personnel, fuel supplies, proper safety precautions, etc. Generator shall not be left unattended while in operation.
- F. The Contractor shall provide temporary construction lighting and power as required in areas where work is being performed. Temporary power arrangements, outages, installation, work schedules, etc., shall be submitted in writing 3-weeks prior to requested outage date, and approved by the District's Representative prior to start of work.

1.16 ASBESTOS, POLYCHLORINATED BIPHENYL (PCB) OR HAZARDOUS WASTE:

- A. It is understood and agreed that this Contract does not contemplate the handling of asbestos, PCB or any hazardous waste material. If asbestos, PCB or any hazardous waste material is encountered, notify the District's Representative immediately. Do not disturb, handle or attempt to remove.
- B. Lighting Fixture Demolition Hazardous Materials
 - 1. The removal of existing lighting fixtures will generate Hazardous Material Waste Disposal Contract Documents.
 - a. The existing lighting fixture ballast contains PCB material.
 - b. The existing lighting fixture lamps contain mercury.
 - c. The existing lighting fixture internal wire insulation may contain asbestos.
 - 2. Remove, handle, store, contain, dispose of and document the hazardous materials resulting from existing lighting fixtures work, as part of the Contract Requirements.

1.17 TIME/CURRENT COORDINATION, SHORT CIRCUIT, ARC-FLASH AND SERIES RATED EQUIPMENT

- A. Series Rated Equipment.
 - 1. Circuit protective Devices identified as "Series Rated" or "Current Limiting" (i.e., CLCB - Current Limiting Circuit Breaker; CLF - Current Limiting Fuse, etc.) shall be Series Rated and Tested (UL 489 and CSA5) by the Manufacturer with all equipment and circuit protective devices installed down-stream of the identified series rated or current limiting device.
 - 2. Provide nameplates on all equipment located downstream, including the CLCB and CLF devices, to comply with CEC/NEC paragraphs 110-22 and 240-83 "CAUTION SERIES RATED SYSTEM - NEW DEVICE INSTALLATIONS AND REPLACEMENTS SHALL BE THE SAME MANUFACTURER AND MODELS".
- B. Short Circuit, Coordination and Arc-Flash
 - 1. Perform Engineering Analysis and submit engineered settings for each equipment location, fuse and circuit breaker device, showing the correct time and current settings to provide the selective coordination within the limits of the specified equipment. Shall comply with the latest application Standards of IEEE and ANSI. Provide electrical system

short circuit worst case bolted-fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric Arc-Flash calculations as part of the Coordination Analysis recommendations.

2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.
3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
 - a. IEEE-242, Recommended Practices for Protection and Coordination of Industrial and Commercial Power Systems.
 - b. IEEE-399, Recommended Practices for Industrial and Commercial Power Systems Analysis.
 - c. IEEE-1584, Guide to Performing Arc-Flash Hazard Calculations.
 - d. CEC/NEC
4. Provide permanent warning labels on each equipment location. The labels shall describe Arc-Flash, Short-Circuit and Time/Current Coordination, including safety precautions and protective clothing. Also described actions to be taken if any circuit changes or equipment modifications occur.
5. Shall be submitted with the Shop Drawing submittals for the respective equipment.

1.18 INDEPENDENT TESTING LABORATORY

- A. Testing Laboratories Definition
 1. The Testing Laboratory shall meet Federal OSHA Criteria for accreditation of Nationally Recognized Testing Laboratories (NRTL) Title 29 Part 1907 and 29 CFR-1910.
 2. Membership in the National Electrical Testing Association (NETA) shall also constitute acceptance of meeting said criteria, for testing of electrical systems.

1.19 SPARE FUSES

Provide three spare fuses for each size and type at each location to match the installed fuses where the fuses are provided as part of the Contract. Provide spare fuse holders on inside door of each respective fuse compartment. Provide engraved nameplate on front of fuse access door indicating fuse type/catalog number ampere rating and Manufacturer of fuse.

1.20 EQUIPMENT SEISMIC AND WIND LOAD REQUIREMENTS (ADDITIONAL REQUIREMENTS)

- A. Refer to Structural, Architectural, and Soils Report Contract Documents for Additional Requirements.
- B. General
 1. Equipment supports and anchorage's provided as part of the Contract shall be designed, constructed and installed in accordance with the Earthquake Regulations of the California Building Code (CBC), International Building Code (IBC).
 2. Provide equipment anchorage details, coordinated with the equipment mounting provision, prepared, signed and "stamped" with PE Registration in good standing, by a

Civil or Structural Engineer Licensed as a Professional Engineer (PE) in the State of California.

3. Mounting recommendations shall be provided by the Manufacturer based upon approved shake-table tests used to verify the seismic design of that type of equipment.
4. The Equipment Manufacturer shall document the details necessary for proper wind-load and seismic mounting, anchorage, and bracing of the equipment for floor, ceiling and wall/back installation location.
5. Seismic performance shall be based on actual install location of the respective equipment in the building and height above or below grade.
6. The Seismic Requirements are typical for each equipment item exceeding 19-pounds, including but not limited to the following:
 - a. Switchgear, switchboards, and motor control equipment
 - b. Transformers
 - c. Equipment racks and terminal cabinets
 - d. Panels
 - e. Conduits with floor, ceiling or wall attachment support and conduits with suspension attachments.
 - f. Busway, wire way and cable tray
 - g. Uninterruptable Power Supplies (UPS)
 - h. Inverters
 - i. Generators and related equipment
 - j. Lighting equipment
 - k. Fire alarm equipment

C. Certification

1. Electrical Equipment Manufacturers and Contractor shall provide Special Seismic Certification (SCC) for each specific equipment configuration with shake-table verification, all furnished as part of the Contract Documents Requirements. The SCC shall include the specific installation location characteristics of the respective equipment including as follows:
 - a. Ground or floor attachment
 - b. Wall attachment
 - c. Ceiling attachment
 - d. Roof attachment
2. Wind Loading

Electrical equipment and anchorages shall withstand the wind-load imposed at the install location. Wind Loading Withstand Requirements shall apply to all electrical equipment installed in outdoor locations and to all electrical equipment exposed to the weather. The equipment shall be Tested and Certified by the Manufacturer and Contractor. The Wind-Load Withstand Qualification of the equipment and anchorages shall be verified by the following methods:

 - a. Aerodynamic wind tunnel test method.

- b. Analytical calculation method, for oversized equipment too large for wind tunnel test method.
3. The Wind-Load Withstand Rating and the SCC shall comply with the Requirements of the Authority Having Jurisdiction (AHJ), and include the latest revisions, but not limited to the following:
- a. American Society of Civil Engineers; ASCE-7
 - b. CBC/IBC; including but not limited to Sections 1702, 1708, 1709, 1708A and 1709A.
 - c. California Office of Statewide Health Planning and Development OSHPD; OPA-Preapproval of Anchorage; Code Application Notice CAN 2-1708A.5 and OSP-Special Seismic Certification Approval.
 - d. US Department of Homeland Security; FEMA - (installing seismic restraints for electrical equipment).
- D. Wall Mounted Electrical Equipment
- 1. Surface Mounted Equipment
 - a. Provide multiple horizontal sections of metal “C” channels for support and attaching wall mounted equipment to walls. Channels shall provide “turned lips” at longitudinal edges to hold “lock-in” fasteners and shall comply with ANSI-1008 and ASTM-A569 latest revision. The channels shall be steel hot dip zinc galvanized. As manufactured by Unistrut or Kindorf.
 - b. The “C” channels shall be positioned horizontally within 3-inches of the top and bottom of each, equipment section cabinet and located behind each equipment vertical section. Provide additional intermediate “C” channels at not less than 36-inches on center between the “top” and “bottom” “C” channel positions, located behind each equipment vertical Section.
 - c. The “C” channels shall be of sufficient length to provide connection to not less than two vertical structural wall framing elements separated by not less than 16-inches; but in no case shall the “C” channel length be less than the width of the respective Equipment Section.
 - d. Attach the “C” channels to the wall structural elements after the wall, finish surface, installation (including painting) is complete.
 - e. Attach the “C” channels with fasteners to the building wall framing structural elements as follows: welded to steel framing; bolted to wood framing; cast in place concrete inserts for masonry and concrete construction; drilled “afterset” expansion anchors for existing masonry and concrete construction.
 - f. Attach the equipment to the “C” channels with threaded and bolted fasteners to “pre-locate” and lock into the channel “turned lips” and channel walls.
 - 2. Flush mount equipment
 - a. Provide anchor attachment of equipment into adjacent wall structural elements.
- E. Housekeeping Pad
- 1. Provide cast-in-place, steel re-enforced concrete raised “housekeeping” pads under all floor standing electrical equipment (except data network equipment racks).

2. Pad sizes
 - a. The raised housekeeping pad height shall extend 4-inches above the surrounding finished floor elevation for interior building locations.
 - b. The pad shall extend 8-inches below finish grade plus 4-inches above finish grade for outdoor equipment location on grade.
 - c. The pads shall extend 7-inches past the “footprint” edge of the respective floor standing equipment.
3. Anchor equipment to pads. Anchor pads to the building structural floor. Equipment pad, equipment re-enforcing and equipment anchoring shall comply with Seismic Earthquake Requirements and Wind Load Requirements.
4. Unless shown otherwise on Drawings. The equipment housekeeping pad steel re-enforcing shall consist of two layers of Number 4-size steel-rebar laid horizontally and uniformly spaced 6-inches on center. Position rebar in two directions (90-degrees opposed) and centered inside the concrete house-keeping pad. Horizontal rebar shall extend to within 3-inches of the edge of the concrete pad in all directions. Metal wire “tie-wrap” shall be provided at each rebar crossing.
5. Equipment anchor attachments shall extend through the housekeeping pad and into the structural concrete below the pad a minimum of not less than 2-inches.

1.21 ELECTRICAL WORK CLOSEOUT

- A. Prepare the following items and submit to the District’s Representative before final acceptance.
 1. Two copies of all test results as required under this Section.
 2. Two copies of Local and/or State Code Enforcing Authority’s Final Inspection Certificates.
 3. Copies of Record Drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.
 4. Two copies of all receipts transferring portable or detachable parts to the District’s Representative when requested.
 5. Notify the District’s Representative in writing when installation is complete and that a Final Inspection of this work can be performed. In the event any defect or deficiencies are found during this Final Inspection they shall be corrected to the satisfaction of the District’s Representative before final acceptance can be issued.
 6. List of spare fuses and locations identified by equipment name and building designation.
 7. Prior to energizing, retighten to the proper torque, each circuit conductor lug landing, each bus bar (phases, neutral and ground) and circuit protection device threaded connections in all switchboards, switchgear, motor control centers, transformers, busways, disconnect switches, motor starters, motor terminals and panelboards, after the equipment is installed/connected and prior to energizing the equipment. The torque values shall comply with Manufacturer's recommendations.
- B. Electrical Power Single Line Diagrams – SLD
 1. Provide single line diagrams showing the Contract Document Work complete electrical power system (normal and emergency). SLD shall show inter-connection circuits, electrical equipment, panels, and circuit protection devices, nominal 50% (½-size)

approximately 18-inches by 24-inches. Show installed voltages and electrical capacity sizes.

2. SLD shall be mounted in metal (picture frame) rigid enclosure frame with rigid-backing (backer-board) and clear/transparent front, for hanging on wall. Provide clear transparent cover over SLD inside the frame.
3. Provide a wall-hung (\pm 48-inches) SLD in each "main" and "sub" electrical equipment room. If wall space is limited, alternatively securely attach SLD frame to room door facing into the respective electrical room.

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SECTION 26 05 01
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit product data sheets for all outlet boxes, floor boxes, wiring devices, device plates, relays, contactors, time switches, and disconnects fuses.
- B. Submit Detailed Shop Drawings including Dimensioned Plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts for transformers, relays, time clocks, and photocells.
- C. Submit Transformer Test Reports.
- D. Submit Material List for Outlet Boxes.

PART 2 - PRODUCTS

2.01 OUTLET AND JUNCTION BOXES

- A. General:
 - 1. Flush or concealed outlet boxes and junction boxes.
 - a. Non-masonry and/or non-concrete locations provide pressed steel boxes. Steel thickness not less than 0.062-inch, hot-dip galvanized. Knockout (KO) type with conduit entrances and quantities size to match conduits shown connecting to respective junction box and outlet box.
 - b. UL-514 listed and labeled.
 - c. Minimum required box depth is exclusive of extension-ring depth.
 - d. Provide all boxes with matching cover plates. Cover plates shall be gasketed water-tight in wet and outdoor locations.
 - e. Boxes installed in masonry or concrete shall be UL "concrete-tight" approved for installation in concrete, and shall allow the placing of conduit without displacing reinforcing bars.
 - 2. Provide outlet boxes of proper Code size for the number of wiring devices, connecting conduits, and conductors/cables or conduits passing through or terminating therein. In no case shall outlet box be less than 4.0-inches square by 2.125-inches deep. Unless

specified elsewhere or noted otherwise on the Drawings, 2.5-inches minimum depth for box width's exceeding 2-gang.

3. Increase the minimum outlet box size to 4.69-inches square by not less than 2.125-inches deep, where one or more of the following conditions occurs:
 - a. More than two conduits connect to the outlet box.
 - b. Circuit "Homerun" or Conduit "Homerun" connects to outlet box.
4. Signal, Communication and Low Voltage Outlet Boxes:
 - a. Individual or duplex audio/visual, telephone, computer or data outlets: 4.69-inches square by 2.125-inches deep minimum with single gang wide extension ring.
 - b. Combination AV/signal/telephone/data or computer outlets: 4.69-inches square by 2.125-inches deep minimum with 2-gang wide extension ring.
5. Junction boxes shall be sized to comply with the following:
 - a. Code Requirements size based on the conduit quantities, conduit sizes and wire-fill connected to the junction box.
 - b. Junction box minimum size shall not be less than 4.69-inches square by 2.5-inches deep, but not less than size indicated on the Drawings or required by Code.
6. Provide extension rings on flush outlet boxes and flush junction boxes, to finish face of extension ring flush to (within ± 0.63 -inches) of finished building surfaces. Extension ring shall match outlet box materials/construction and contain "attachment mounting-tabs" for wiring devices. Extension rings shall be "screw-attached" to respective box and maintain "ground" bonding continuity.
7. Outlet boxes installed in outdoor locations, or in wet locations, or in concrete/masonry, shall be cast-iron or cast-bronze, with threaded conduit hubs. UL rated for wet locations.
 - a. Aluminum boxes shall NOT be in contact with concrete or masonry. Die-cast aluminum or cast aluminum water-tight electrical outlet boxes with threaded hubs may be provided as an alternate to cast-iron or cast-bronze outlet boxes, only where one or more of the following conditions occur:
 - 1) Outdoor locations above finish grade.
 - 2) Indoor wet locations surface or flush in walls or ceilings.
 - 3) Not in contact with concrete or masonry.
8. Provide fixture-supporting device in outlet boxes for surface mounted fixtures as required.
9. Provide solid gang boxes for three or more devices, typical for line and low voltage switches, receptacles, low voltage/signal outlets, etc. for mounting devices behind a common device plate.
10. Provide isolation barriers in outlet boxes:
 - a. Between line voltage and low voltage devices.
 - b. Where more than one device is installed in an outlet box, between and separating each device.
 - c. Between 277-volt and 120-volt devices.
 - d. Between devices connected to emergency and non-emergency circuits of all volt-ages.

11. Outlet boxes installed penetrating into fire rated walls, fire rated floors, fire rated ceilings and all fire rated construction. The outlet boxes shall be UL listed, classified and labeled, for fire rated and temperature rated penetration of the respective fire rated surface and fire rated construction. The outlet box fire rating and temperature rating shall equal or exceed the fire/temperature rating of the surface/ construction being penetrated. Provide UL listed and labeled supplemental fire and temperature protection to maintain ratings:
 - a. Wall and ceiling penetrations, supplemental tumescent fire wrap (external or internal of outlet box).
 - b. Floors provide subfloor supplemental fireproofing below floor box.
 12. Outlet boxes installed in floors. The floor outlet boxes shall be UL listed and labeled for Scrub Water Exclusion Requirements, including but not limited to tiles, carpeting and exposed wood and concrete floor finishes.
 13. Outdoor flush in wall device outlet boxes:
 - a. Flush in wall outlet box with corrosion resistant gasketed water tight, hinged, key locking cast metal, self-closing cover. Tamper resistant and vandal resistant.
 - b. UL-listed and labeled for installation in masonry, cast-in-place concrete, hollow-framed walls and wet locations.
 - c. Flush cast-iron or cast-bronze or brass, device back-box, nominal 4.68-inch square by 2.25-inch deep.
 - d. Internal metal adapter plate for wiring device types, in the box as indicated on the Drawings.
 - e. As manufactured by Legrand/Pass and Seymour #4600 Series; or C.W. Cole #310 Series.
 14. PVC Coating
 - a. Metal outlet and junction boxes installed in outdoor or exposed non-weather protected locations shall be PVC coated.
 - b. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.
 - c. The adhesion of the PVC coating to the metal box shall exceed the strength of the coating itself, based on 0.5-inch "strip-pull" test.
 - d. Uniform coating thickness shall be continuous without "breaks" or "pinholes" and shall not be less than the following:
 - 1) Box exterior surfaces, 40-millimeter coating thickness.
 - 2) Box interior surfaces, 10-millimeter coating thickness.
 15. Refer to Architectural and Structural Contract Documents and Details for Additional Box and Install Requirements.
- B. Surface Outlet Boxes
1. Surface mounted outlet boxes, cast iron Type FS or FD, with threaded hubs as required. Box interior dimensions and interior volume capacity not less than required for "press steel boxes" and "sheet steel boxes". Provide plugs in all unused openings. Provide weatherproof gaskets for all exterior boxes.

C. Floor Boxes

1. General:

- a. Outlet boxes installed in floors. The floor outlet boxes shall be UL listed and labeled for Scrub Water Exclusion Requirements, including but not limited to floor tiles, carpeting and exposed wood and concrete floor finishes.
- b. Electrical power receptacles in a floor box; shall be industrial grade wet location heavy-duty, high-abuse rated devices, tamper resistant. Grounding type, 125 volts, 60Hz AC, 20-amp, NEMA 5-20R (duplex), or other NEMA configurations noted on the Drawings. Standard length receptacle mounting strap as required by the Manufacturer of floor box being furnished.
- c. Tested, listed and labeled to comply with UL-514A and/or UL514C.

2. Poke-Thru floor boxes for "After-Set" Floor Outlets.

- a. Through floor wiring for power and communication shall be UL listed with a fire and temperature rating of not less than 2-hours. The units shall include an internally divided floor fitting; a divided through-floor conduit/ raceway, and a divided under floor junction "split-box" not less than 4.7-inches by 4.7-inches by 2.125-inches in size. Junction box shall be installed concealed in ceiling space of the floor below. The length of the floor "through-raceway" shall match the thickness of the finish floor and as recommended by the Manufacturer. Unit shall be self-supporting without the attachment of an above floor fitting. Internal isolation barriers between high potential and low potential circuits and sections. The integral fire barrier shall incorporate a cold smoke barrier to prevent the passage of smoke when heat is not present.
- b. Poke-Thru Floor boxes shall contain dual services for high potential and low potential devices and circuits.
- c. Non-Pedestal Poke-Thru flush in floor type; (internal divided high potential and low potential sections) die cast, flush with finish floor, metal cover flip-open, locking, hinged access covers. Open-close die cast aluminum port-covers for plug-in portable cable connections. ADA compliant, wide trim matching flange.
 - 1) Two 20-amp, 120 volt, 60Hz, AC, grounding duplex convenience receptacles for high potential power connections.
 - 2) Four RJ-45 keystone, snap-in retainers for low potential plug-in signal connections. The Contractor shall provide the type of outlet(s) at each poke-thru location as required by the Low Voltage-Signal Contract Documents.
 - 3) Cover shall close and lock after portable plug-in cables have been inserted into respective connections, under the cover.
 - 4) UL wet mop, scrub water rated for carpeted and non-carpeted floors.
- d. Die cast aluminum cover, nominal 8-inch diameter metal housing flush in "core-hole", outlet metal body size.
- e. Flush with floor or pedestal type as indicated on Drawings. As manufactured by Wire-mold/LeGrand# Evolution Poke-Thru 8AT Series, Smoke and Fire Rated Poke-Through fittings; no known equal.

4. Floor Boxes for Flush Floor Outlets (non-pedestal), recessed concealed inside outlet box, plug-in receptacles.
 - a. Provide cast-in-floor with concrete pour pan, rated for on grade to prevent direct earth contact, cast-in-place concrete floors on-grade and above-grade; adjustable "leveling-feet" for box.
 - b. UL wet mop, scrub water rated for carpeted and non-carpeted floors. UL-File E171211 installation fire rating and/or UL-Fire Resistance Classified.
 - c. Floor boxes shall contain dual services:
 - 1) High potential with not less than two 120 volt 60Hz AC 20-amp grounding duplex convenience receptacles.
 - 2) Low potential for low voltage system outlets and signal circuits with up to and including eight RJ-45 plug-in keystone snap-in retainer receptacles. The Contractor shall provide the type of outlet(s) at each poke-thru location as required by the low voltage-signal Contract Documents.
 - 3) Internal isolating barrier between high and low potential circuits and sections of box.
 - 4) Also refer to Drawings for additional outlet Requirements.
 - d. Conduit knockouts in bottom of box and in each side walls of box. Not less than one 1.25-inch and one 0.75-inch knockouts for both low potential and high potential conduits connections on each opposing box sides. Include the same configuration of knockouts on the bottom of the box, for high potential section and low potential sections.
 - e. Floor box cover:
 - 1) Flush tamper resistant "lock-down" removable main cover. Independent hinged "flip-out" port in the removable cover, to allow main box cover to be in a fully closed position with "plug-in" cords connected into box when the lock-down cover is closed. Main cover "lock-down" to prevent non-authorized access into box interior.
 - 2) Brass, removable recessed main cover, rated for carpet, or tile for floor finish, brass overlapping trim cover finish. Cover recess depth 0.25-inch, 0.5-inch or 0.75-inch as required to match respective floor covering thickness and type. ADA compliant, wide trim matching flange.
 - f. Floor box with metal body, nominal box size 10-inches by 12-inches by depth to match floor, but not less than 3.0-inches deep box.
 - g. Floor box as manufactured by FSR #FL-500P Series; no known equal.

2.02 PULL BOXES

A. General

1. Sizes as indicated on the Drawings and in no case of less size or material thickness than required by the Governing Code and AHJ.
2. Exercise care in locating pull boxes to avoid installation in drain water flow areas and to clear existing condition interferences.
3. UL listed and labeled for electrical circuits.

B. General Purpose Sheet Metal Pullbox

1. General purpose sheet steel pull boxes: Install only in dry protected locations with removable screw attached covers. Manufacturer's standard rust proofing and baked enamel finishes.
2. Weatherproof sheet steel pull boxes: Fabricate of Code gauge steel. All surfaces interior and exterior hot-dip galvanized steel. Gasketed weathertight cover of same material.

C. Concrete Pull Boxes and Hand-Holes for Electrical

1. AASHTO H-20 traffic loading rated box and cover, pre-cast concrete, steel reinforced pull boxes and hand-holes. Provide complete with pulling irons, hot-dip galvanized metal traffic cover with hot-dip galvanized metal cover frame, pull-box concrete base with sump. Four cable full height wall racks with porcelain cable support blocks.
2. Boxes shall be "Intercept" type with Multiple Box Sections. Extension cable-intercepts at both ends of box. Refer to Drawings for box size.
3. Covers shall be flush bolt down. Covers weighing more than 40-pounds shall be split cover type "Torsion-Spring" assist, hinged open-close.
4. Box covers shall comply with Federal ADA, UL, State and Local AHJ for slip resistance. Provide cast-or-bead weld on cover of pull box to indicate services within pull box (i.e., "480/277-VOLT, 3-PHASE, 4-WIRE ELECTRICAL" OR "SIGNAL/TEL/P.A./ CLOCK/FIRE ALARM" etc.).
5. Shall be set on a machine-compacted pea gravel base 12-inches thick with gravel base extend 6-inches beyond box base on all sides. Provide a 0.75-inch by 10-foot copper clad ground rod through the box bottom with 9-inch projection into box, for grounding all metal parts and frames with continuous #10 AWG copper bond wire.
6. Seal all box joints and seal box between cover and frame with a mastic compound similar to Parmagum or Dukseal. After cables have been pulled, connected, tested and inspected, seal box cover and bolt-close cover.
7. As manufactured by Jensen Precast; or Oldcastle Precast.

2.03 SWITCHES, WIRING DEVICES

A. General

1. Provide wiring device circuit switches totally enclosed, electrical insulating Bakelite or electrical insulating composition base, manual operator type with 277 volt 60Hz AC rating for full capacity contacts rated for incandescent lamp loads, fluorescent lamp loads and motor loads. Switch mounting-ears for screw attachment to outlet box. Switches shall be UL listed and labeled; conform to NEMA-WD1 and WD6.
2. Switch controlling (on-off) rated for all lighting loads and all non-lighting loads; switch ratings shall be 20-amp; unless indicated otherwise on Drawings.
3. Color as selected by Owner's Representative. Switches and wiring devices controlling circuits connected to emergency power shall be red.
4. All switches shall be of the same Manufacturer.
5. Where switches are mounted in multiple gang assembly and are operating at 277 volts and/or 277 volts and 120 volts or emergency/non-emergency and mounted in same outlet box, there shall be an insulating barrier installed between each switch.

6. Devices shall additionally be listed and labeled as UL-All Weather-Resistant wet-location for the following install locations:
 - a. Devices indicated on Drawings as Weather-Proof (W.P.).
 - b. Devices installed in outdoor locations
 - c. Installed in classified wet or damp area locations both indoor and outdoor.
7. Wiring devices shall be listed and labeled for connection of both “solid” and “stranded” copper circuit conductors.
8. Switches with ampere and voltage ratings different than described herein. The different rated switches shall have the same characteristics and performance as the respective described switches, except for differing ampere and voltage characteristics.

B. Switches Heavy Duty (Toggle – Type)

1. Single Pole Switches – 20 amp at 277V

<u>Manufacturer</u>	<u>Toggle Type</u>	<u>Lock Type</u>
Hubbell	#HBL1221	#HBL1221-L
Legrand/P&S	#20AC1	#20AC1-L
Leviton	#1221	#1221-L
Cooper-Arrow/Hart	#AH1221	#AH1221-L

2. Double Pole Switch – 20 amp at 277V

<u>Manufacturer</u>	<u>Toggle Type</u>	<u>Lock Type</u>
Hubbell	#HBL1222	#HBL1222-L
Legrand/P&S	#20AC2	#20AC2-L
Leviton	#1222	#1222-L
Cooper-Arrow/Hart	#AH1222	#AH1222-L

3. Three-Way Switches – 20 amp at 277V

<u>Manufacturer</u>	<u>Toggle Type</u>	<u>Lock Type</u>
Hubbell	#HBL1223	#HBL1223
Legrand/P&S	#20AC3	#20AC3-L
Leviton	#1223	#1223-L
Cooper-Arrow/Hart	#AH1223	#AH1223-L

4. Four-Way Switches – 20 amp at 277V

<u>Manufacturer</u>	<u>Toggle Type</u>	<u>Lock Type</u>
Hubbell	#HBL1224	#HBL1224-L
Legrand/P&S	#20AC4	#20AC4-L
Leviton	#1224	#1224-L
Cooper-Arrow/Hart	#AH1224	#AH1224-L

5. Momentary Contact Switches – 20 amp at 277V

<u>Manufacturer</u>	<u>3-Position Regular</u>	<u>3-Position Lock</u>
Hubbell	#HBL1557	#HBL1557-L
Legrand/P&S	#1251	#1251-L
Leviton	#1251	#1251-L
Cooper-Arrow/Hart	#AH (extra)	#AH (extra)

6. Maintained Contact Switches (Double Throw, Center Off) – 20 amp at 277V

<u>Manufacturer</u>	<u>Toggle Type</u>		<u>Lock Type</u>	
	<u>1-Pole</u>	<u>2-Pole</u>	<u>1-Pole</u>	<u>2-Pole</u>
Legrand/P&S	#1225	#1226	#12250L	#1226-L
Hubbell	#HBL1385	#HBL1386-L	#HBL1385-L	#HBLM1386-L
Leviton	#1385	#1386		
Cooper-Arrow/Hart	#AH(extra)	#AH (extra)	#AH (extra)	#AH (extra)

7. Pilot lights used in conjunction with circuit switches shall be LED type with red jewel.

C. Switches

1. 120 volt 60Hz, AC, rated 15 amp for lighting loads and rated 20 amp for non-lighting loads, unless indicated otherwise on Drawings.

2. Single Pole Switches

<u>Manufacturer</u>	<u>Rocker Type</u>
Legrand/P&S	#TM870
Hubbell	#RSD115
Leviton	#5621-2
Cooper-Arrow/Hart	#7501

3. Double Pole Switch

<u>Manufacturer</u>	<u>Rocker Type</u>
Legrand/P&S	
Hubbell	#RSD215
Leviton	#5622-2
Cooper-Arrow/Hart	#7502 (extra)

4. Three-Way Switches

<u>Manufacturer</u>	<u>Rocker Type</u>
Legrand/P&S	#TM873
Hubbell	#RSD315
Leviton	#5623-2
Cooper-Arrow/Hart	#7503

5. Four-Way Switches

<u>Manufacturer</u>	<u>Rocker Type</u>
Legrand/P&S	#TM874
Hubbell	#RSD415
Leviton	#5624-2
Cooper-Arrow/Hart	#7504

6. Momentary Contact Switches

<u>Manufacturer</u>	<u>3-Position Regular</u>
Legrand/P&S	#TM870 (extra)
Hubbell	#RSD (extra)
Leviton	#5624-2
Cooper-Arrow/Hart	#7521

7. Maintained Contact Switches (Double Throw, Center Off).

<u>Manufacturer</u>	<u>Rocker Type</u>	
	<u>1-Pole</u>	<u>2-Pole</u>
Leviton	#5685-2	#5686-2

8. Pilot lights used in conjunction with circuit switches shall be LED type with red jewel.
- D. Weather-Proof (W.P.) Switches
1. Outdoor switches provide heavy-duty, tamper resistant gasketed weather proof metal, hinged door cover for each switch.
 2. Cover door shall be key locking-type or padlock-type.
- E. Other Switches, Receptacles, Devices, and Outlets
1. Special devices outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.04 ELECTRIC RECEPTACLE WIRING DEVICES

A. General

1. All receptacle wiring devices in flush type outlet boxes shall be installed with a bonding jumper to connect the box to the receptacle ground terminal. Grounding through the receptacle mounting straps is not acceptable. The bonding jumper shall be sized in accordance with the branch circuit protective device as tabulated herein under "Grounding". Bonding jumper shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws 6-32 or larger (except isolated ground receptacles). For receptacles in surface mounted outlet boxes direct metal-to-metal contact between receptacle mounting strap (if it is connected to the grounding contacts) and outlet box may be used. Receptacle mounting-ears for screw attachment to outlet box. Receptacle shall be UL listed and labeled; conform to NEMA-WD1 and WD6.
2. All receptacles shall be a product of the same Manufacturer.
3. Receptacle color as selected by Owner's Representative. Receptacles connected to emergency power circuits shall be red.
4. Tamper Resistant Receptacle
 - a. Devices shall additionally be listed and labeled as tamper resistant, provide tamper resistant receptacles in buildings containing: dormitories, guestrooms, housing/residences, condominiums, apartments, dwellings, hotels/motels, class-rooms, secondary schools K through 12th grade, childcare/daycare/kindergarten, hospital pediatric-care units and other locations required by AHJ.
 - b. The electrical receptacles shall be rated "Tamper-Resistant-Receptacle" (TR), UL-TR (TRTR). Spring loaded shutters shall automatically open-close (unblock-block) the receptacle slots, when the plug-in (cap) insertion and removal occurs.
 - c. Typical for 15-amp and 20-amp receptacles. Modify Manufacturer's catalog number description to include tamper resistant receptacle function.
5. Wiring devices shall be listed and labeled for connection of both "solid" and "stranded" copper circuit conductors.
6. Duplex convenience receptacles and 120-volt single phase branch circuits.
 - a. Duplex (convenience) receptacle, wiring device with two single receptacles with the same electrical rating, integrated into a single assembly by the Manufacturer.

- b. 20-amp branch circuits with a single duplex convenience receptacle connection on each circuit, receptacles shall be rated for 20-amp.
 - c. 15-amp and 20-amp branch circuits with two or more duplex convenience receptacle connections each circuit, receptacle shall be rated 15-amp or 20-amp.
7. Devices shall additionally be listed and labeled as UL-All Weather-Resistant, provide weather resistant receptacles for the following install locations. Modify Manufacturer’s catalog number descriptions, shall include all-weather-resistant UL listing and labeling:
 - a. Devices indicated on Drawings as Weather-Proof (W.P.).
 - b. Devices installed in outdoor locations.
 - c. Devices installed in classified as damp or wet locations both indoor and outdoor.
 - d. All GFCI (ground-fault) receptacles all locations.
 8. Receptacles with ampere and voltage ratings different than described for duplex convenience receptacles. The different rated receptacles shall have the same characteristics and performance as the respective duplex convenience receptacles, except for differing ampere and voltage characteristics. Refer to “Floor Boxes” for additional receptacle Requirements”.
 9. Receptacles shall be GFCI type for the following locations:
 - a. located within 84-inches of a sink or hosebib shall be GFCI receptacles.
 - b. Devices installed in outdoor locations.
 - c. Devices installed in classified as damp or wet locations both indoor and outdoor.
 - d. Devices indicated on Drawings as GFCI or Weather-Proof (W.P.).
 10. “Split-wire” duplex convenience receptacles. Each split-wire receptacle plug connects on independent common circuit. Provide nameplate or graphic on face of receptacle describing the receptacle function and control source. Comply with California Title-24 and ASHRAE-90.1, latest revisions.
- B. Duplex convenience receptacles.
1. Shall be grounding type, 120 volt and shall have two current carrying contacts and one grounding contact which are internally connected to the frame. Outlet shall accommodate standard parallel blade cap and shall be side wired. Receptacles shall be tamper resistant–TR, UL-TR.
 2. GFCI receptacles shall be all Weather-Resistant and wet location rated. Duplex, rated 120 volt 60Hz, AC, 20 amp, unless indicated otherwise on Drawings.
 3. Heavy Duty Industrial Grade
- | <u>Manufacturer</u> | <u>NEMA 5-15R</u> | <u>NEMA 5-20R</u> | <u>NEMA 5-20R-GFCI</u> |
|---------------------|-------------------|-------------------|------------------------|
| Legrand/P&S | #5262 | #5362 | #2095HG |
| Leviton | #5262 | #5362 | #W7899 |
| Hubbell | #CR5252 | #5362 | #GFR8300 |
| Cooper-Arrow/Hart | #AH5262 | #AH5362 | #WRVGF20 |
- C. Isolated Ground Receptacles-IGR
1. The receptacle insulation barrier shall isolate the receptacle ground contact system from ground. Connect the ground plug contact to a separate dedicated insulated ground-bonding conductor. The receptacle ground plug contact shall not be grounded to the raceway or outlet box. Isolated ground duplex convenience receptacle 20-amp

minimum, with two current carrying contacts and one grounding contact, or as noted on the Drawings.

2. High-abuse, heavy-duty industrial grade, NEMA 5-20R, duplex convenience receptacles.
3. Identify receptacle with an orange triangle on the receptacle face and orange receptacle body. Red body for receptacles connected to emergency power.

<u>Manufacturer</u>	<u>NEMA 5-20R</u>
Legrand/P&S	#IG6300
Leviton	#5362IG
Hubbell	#CR5352IG
Cooper-Arrow/Hart	#IG5362

D. Weather Proof (W.P.) Receptacle

1. Outdoor receptacles shall be duplex convenience GFCI type rated 20-amp 120 Volt 60Hz AC weather-proof, GFCI, unless indicated otherwise on Drawings. Test-reset buttons and visual pilot.
2. GFCI receptacles shall be wet location and Weather-Resistant rated weatherproof, gasketed, key locking tamper resistant, wet location.
3. Outdoor, flush mount outlet with hinged, key-locking, weather-proof cover (CEC/NEC – 406.8 compliant). As manufactured by C.W. Cole #310 Series.
4. On exposed conduit runs, provide weatherproof ground fault circuit interrupter type GFCI receptacles installed in "FS" conduit water tight cast metal body, with weather-proof spring door type covers, gasket water tight. Door shall be key locking-type or pad-lock-type.

G. Other Switches, Receptacles, Devices, and Outlets.

Special devices, outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.05 PLATES

A. Metal Cover Plates for Devices

1. Provide cover plates for every line voltage and low voltage switch, receptacle, telephone, computer, television, signal and other device outlets.
 - a. All line voltage circuit plates shall be metal, 0.040-inch stainless steel Type 302 alloy, composed of 18% chromium and 8% nickel.
 - b. Plates for low voltage signal systems may be metal or non-metal. Non-metal plates shall be high-abuse, hard-service and high-impact resistant.
2. Plates shall be as manufactured by P&S; or Hubbell; or Leviton; or General Electric.

2.06 VANDAL-PROOF FASTENINGS

Provide approved vandal-proof type screws, bolts, nuts where exposed to sight throughout the Project. Screws for such items as switch plates, receptacle plates, fixtures, communications equipment, fire alarm, blank covers, wall and ceiling plates to be spanner head stainless steel, tamperproof type. Provide Owner with six screwdrivers for this type.

2.07 STRUCTURAL AND MISCELLANEOUS STEEL

Structural and miscellaneous steel used in connection with electrical work and located out-of-doors or in damp locations, shall be hot-dip galvanized unless otherwise specified. Included are underground pullbox covers and similar electrical items. Galvanizing averages 2.0 ounce per square foot and conforms to ASTM A123.

2.08 FLASHING ASSEMBLIES

A. General

1. Flashing shall be compatible with the material being penetrated and with the pipe passing through the flashing. Coordinate with and comply with Manufacturer's recommendations, for both the flashing and the material being penetrated.
2. Provide lead metal flashing assemblies at all roof penetrations, unless recommended otherwise by Manufacturer.
3. Seal the joint between the flashing and pipe passing through the flashing with waterproofing compound.
4. Lead flashing for roof penetrations, as manufactured by: Santa Rosa Lead Products; or Semco; or Flashco.

B. Storm Collars

1. In addition to penetration flashing, provide a storm-collar counter-flashing for each roof penetration flashing. Shall attach to the structure of the penetration and form a water-tight "umbrella" counter flashing over the roof penetration flashing.
2. As manufactured by: STD-Storm collars; or ASI-Storm collars.

2.09 RELAYS, CONTACTORS, AND TIMESWITCHES

A. Individual Control Relays (HVAC Plumbing of the Control Functions)

1. Individual control relays shall have convertible contacts rated a minimum of 10 amp, 600 volts regardless of usage voltage. Coil voltage, number and type of contacts shall be verified and supplied to suit the specific usage as shown in the wiring diagrams and/or schedules on the Electrical and Mechanical Drawings. Coil control circuit shall be independently fused, sized to protect coil. Relays shall be installed on prefabricated mounting strips. Each relay shall have a surge suppressor to limit coil transient voltages. Furnished in the NEMA Type I enclosure unless indicated otherwise.

2. The following relays are approved:

<u>Manufacturer</u>	<u>Type</u>
Cooper-Arrow/Hart	IMP
General Electric	Class CR 2811
Square D Co.	Class 8501, Type A
Westinghouse	Bul. 16-321, Type NH
Allen Bradley	Approved Equal

B. Contactors and/or Relays

1. Contactors and/or relays for control of lighting shall be 600 volt AC, electrically operated, and mechanically held units, open type for panel mounting with number of poles and of

size as indicated on the Drawings. Provide auxiliary control relay for operation of each contactor and/or relay with a 2-wire control circuit.

2. Contactors and/or relays shall be mounted in panelboards in barriered section under separate hinged lockable doors or in contactor and/or relay cabinets as called for on the Drawings. Contactors and/or relays shall be installed on Lord sound absorbing rubber mounts.
3. Contactors and/or relays shall be Automatic Switch Co. Bulletin #920 Series for 2-pole and 3-pole, Automatic Switch Co. Bulletin 917 Series with poles as indicated on Drawings. Coil control circuit shall be independently fused, sized to protect coil.
4. Contactors and/or relays shall be equipped with a switch, in the proper configuration, to disconnect the control circuit controlling the coil of the respective device. Control circuit disconnect switch shall be labeled showing function of device.

C. Time-Switches

1. All timeswitches shall have synchronous motor drive for operation on 120 or 277 volts, 60Hz, AC and shall be furnished with a 10-hour, spring-driven, reserve-power motor. Contacts shall be rated 40-amp per pole.
 - a. Exterior lighting timeswitches for control of individual circuits or electrically operated relays shall have astronomic dial and shall be Tork 7000ZL Series or approved equal by Paragon or Intermatic.
 - b. Interior lighting timeswitches for control of individual circuits or electrically operated relays shall be Tork 7000 Series or approved equal by Paragon or Intermatic.
 - c. Timeswitches for control of air conditioning or plumbing equipment shall have seven day dial and shall be Tork WL Series or approved equal by Paragon or Intermatic.
2. All timeswitches shall be mounted in separate section in top of panelboards under separate lockable door unless otherwise indicated on Drawings. Clear opening for time-switch shall be a minimum of 12-inches by 12-inches.

D. Contactors and/or Relays/Timeswitch Cabinet

1. Contactors, relays, and/or timeswitches not indicated to be mounted in electrical panels shall be mounted in a cabinet, size as required, with hinged lockable door keyed same as panelboards. Construction of cabinet shall be similar to terminal cabinets.
2. Each contactor, relay or timeswitch mounted in the contactor cabinet shall be barriered in its own compartment, and shall be installed on Lord sound absorbing mounts.
3. Contactor cabinets shall be of the same Manufacturer as the panelboards.
4. Where relays and/or contactors occupy the same enclosure as timeswitches they shall have a clear acrylic shield installed over each relay or contactor to guard line exposed parts from accidental contact by nonauthorized personnel.

2.10 DISCONNECTS (SAFETY SWITCHES)

A. General

1. Disconnect switches shall all be rated:
 - a. 600 volt 60Hz AC for all disconnect safety switches.
 - b. NEMA Type HD, quick-make, quick-break, H.P.-rated.

- c. Fused Class "R", in NEMA Type I indoor location enclosure. Where enclosure is indicated outdoor or W.P. (Weather-Proof) switches shall be rain tight NEMA 3R enclosure. Lockable access door.
 - d. Number of poles horse power rating and amperage as indicated on the Drawings.
2. Provide internal neutral bus, ground-lug and conductor landing lugs, size to match conductors shown on Drawings. Switch access door shall be interlocked with switch to prevent access inside switch when switch is "on" closed position.
 3. Maximum voltage, current and horsepower rating clearly marked on the switch enclosure and switches having dual element fuses shall have rating indicated on the nameplate.
 4. Disconnect switch and fuses ampere rating shall also comply with Manufacturer's recommendation for the connected load.

2.11 SPARE FUSE CABINETS

Provide a cabinet in each room where a switchboard or motor control center is installed and contains fuses. Cabinets shall be as specified for "Terminal Cabinets" and shall be of sufficient size to contain all spare fuses hereinbefore specified. Provide clips (two per fuse) for each spare fuse. Mount clips in plywood backboard in cabinet. Label cabinet "SPARE FUSES".

2.12 CONCRETE WORK (ADDITIONAL REQUIREMENTS)

A. Portland Cement

1. ASTM C33-(latest revision), Type II, Low Alkali Cement. Composed of Portland cement, coarse aggregate, fine aggregate, and water.
 - a. Concrete for use as electrical equipment footings, lighting pole bases and equipment slabs on grade, concrete shall attain minimum 28-day compressive strength of 4000psi, using not less than 5.75 sacks of cement per cubic yard of wet concrete.
 - b. Concrete for underground duct/conduit encasement, the minimum 28-day compressive strength shall be 2000 psi. Provide a minimum of 10-pounds of red oxide concrete coloring per yard of concrete.
 - c. Mix shall obtain a 6-inches slump, measured with standard slump cone per ASTM C143/C143M (latest revision).
2. Coarse Aggregate: Uniformly graded between maximum size not over 1½-inch and not less than 0.75-inch and minimum size #4, crushed rock or washed gravel. For concrete encased conduit only, maximum aggregate size shall be ½-inch.
3. Fine Aggregate: Clean, natural washed sand of hard and durable particles varying from fine to particles passing ¾-inch screen, of which at least 12% shall pass fifty mesh screens.

B. Water: Clean and free from deleterious quantities of acids, alkalis, salts, or organic materials.

C. Reinforcement

1. Bars: Intermediate Grade Steel conforming to ASTM A615/A615M Grade 60, with pattern deformations.
2. Welded Wire Fabric: ASTM A185/A185M.
3. Bending: Conform to Requirements of 2018 IBC

- D. Form Material: For exposed work, use PS 1-66 "B-B Concrete Form" plywood forms, or equal. Elsewhere, forms may be plywood, metal, or 1-inch by 6-inch boards. Forms for round lighting pole bases shall be sono-tube.

2.13 SURGE PROTECTION DEVICE PROTECTOR (SPD) – DIRECT CONNECT

A. General

1. The unit shall be modular in construction and operate in parallel with 60Hz AC line voltage, 4-wire or 5-wire, grounded or ungrounded systems, as applicable; voltage, kVA and ampere capacity as indicated on the Drawings. Suitable for direct connection through an external circuit breaker or combination switch/fuse protective device rated 30-amp, continuous duty, rated for Service Entrance equipment connection. Transient electrical surge protection sequences shall include circuit configurations as follows:
 - a. Line-to-Line (Phase-to-Phase).
 - b. Line-to-Ground (Phase-to-Ground).
 - c. Line-to-Neutral, where neutral is present.
 - d. Ground-to-Neutral, where neutral is present.
2. The unit shall operate correctly with any combination of resistive, inductive, or capacitate loads. The unit shall automatically shunt to ground the electrical transients and EMI/RFI noise occurring above the specified values. The unit shall automatically reset after transient condition has passed. Operating temperature minus 40° centigrade to plus 85° centigrade.
3. Provide one or more individual self-contained protection module(s) for each line voltage phase, ground and neutral, suitable for direct connect with line-side C/B protection and disconnect. Provide one spare individual plug-in protection module. Provide incoming line, neutral and ground conductor termination lugs rated CU/AL #14 through #4 AWG. Lugs shall be barriered from and prewired to the respective protection modules.
4. Provide a NEMA twelve housing to contain all unit modules, devices and conductor terminations. The housing shall include a hinged pad-lockable access door.
 - a. Flush housing for mounting internally inside related equipment.
 - b. Surface mounted, with conduit entrance knockouts for external mounting. Maximum housing size shall not exceed 36-inches wide by 72-inches high by 8-inches deep.
5. As manufactured by Total Protection Solutions Model #ST-SPD; or MCG Electronics; or Advantage Protection Technologies, Inc.

B. Operational Characteristics

1. Transient voltage protection, testing, listing and certification.
 - a. UL 1449 (latest edition) and CSA listed and labeling, for Surge Protection Device, UL 1283 for transient voltage electrical noise attenuation, ANSI/IEEE C62.45, C62.1 for C62.41, (latest edition) bi-directional transient clamping voltages for both Normal Mode and Common Modes against Category A and B ring wave and Category B impulse wave.
 - b. The unit connected to the service entrance shall also withstand a minimum of 2,000-sequential ANSI/IEEE C62.41 Category C surges without failure following IEEE Test procedures in C62.1, C62.41 and C62.45.

2. Transient voltage protection, EMI noise rejection, and RFI noise rejection shall be provided for Common Mode (line-to-neutral and line-to-ground), Normal Mode (line-to-line) and neutral to ground.

3. EMI and RFI noise rejection.

Conducted line noises interference both Electromagnetic (EMI) and Radio Frequency (RFI) shall be reduced by the unit over a continuous spectrum of 0.5MHz to 1.0MHz. The basis for reduction shall be a standardized 50-OHM insertion loss MIL -STD-220A test. Provide Spectrum Analysis Test dB attenuation reports showing RFI filtering over specified frequencies. Test data based on calculated or computer simulation is not acceptable.

4. Three phase and grounded "WYE" Performance Requirements.

<u>Characteristics</u>	<u>208/120 Volt</u>	<u>480/277 Volt</u>
Nominal line-to-line	208 Volt	480 Volt
Nominal line-to-neutral	120 Volt	277 Volt
Internal capacitance (Microfarads)	2.5	2.5
Maximum response time	1-nano second	1-nano second
EMI/RFI noise rejection	25-35dB	25-35-dB
Nominal peak clamp voltage line-to- neutral and line-to-ground	500 Volts	900 Volts
Minimum transient energy dissipation per phase (at 8x20 microseconds waveform)	1000 Joules	1500 Joules
Peak transient withstand (at 8x20 micro-seconds waveform) without failure of the unit	50,000 amp	60,000 amp
• Category-C3	300,000 amp	500,000 amp
• Category-B3	100,000 amp	150,000 amp
• Category-A3	60,000 amp	80,000 amp

C. Diagnostic Indicators

1. Shall display the "Normal" and "Fault" status of each line suppression circuit, along with protection circuit "on" indication.

2. Shall provide a sonic audible fault alarm with silence push-button.

D. Surge Suppressor Protection Categories

1. Surge protectors shall comply with ANSI C62.41 (Latest Revision) Standard Protection Categories for "impulse" and "ringwave" transients, based on the installation locations shown in the Contract Documents.

a. Service entrance, main switchboard or substation locations - Category "C3", high exposure, Type-1.

b. Mid building, distribution panels, distribution panels over 400-amp main bus rating locations - Category "B3", high exposure, Type-1.

c. Branch circuit panelboards 400-amp or less main bus rating - Category "A3", high exposure, Type-1.

2. The SPD short circuit current withstand rating shall exceed the actual short circuit current available at the SPD installation location

2.14 PLUG STRIP SURGE PROTECTION DEVICE SUPPRESSOR

A. General:

1. Point-of-Use Type-3 self-contained unit rated 15-amp, nominal 120 volt plus-or-minus 10%, 60Hz, AC, 1875 watts full continuous load. Internal 15-amp resettable overload protection circuit breaker. Red illuminated on-off switch. 6-foot, 14 AWG 3-conductor, grounded, heavy duty jacketed AC line cord with NEMA 5-15 cap. Multi-outlet receptacles, suitable for use with the following types of plug in loads, data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and "switching type" power supplies.
2. Protected outlets shall be NEMA 5-15R 15-amp, AC 60Hz receptacles. Provide four protected outlet plugs on each plug strip, as indicated on the Drawings. Each group of two receptacles (duplex) shall be connected to separate protected load isolated filter banks. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.
3. Non-blocking plug-in locations/orientation for plug-in "power-brick" power supplies, without obstructing adjacent receptacles.
4. As manufactured by TRIPP LITE-Isobar Series; or Advanced Protection Technologies; or equal.

B. Operation:

Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground rated as follows:

1. 13,000-amp, 210 joules (watt-seconds) peak withstands capacity.
2. Transient response time less than 5-nano seconds.
3. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.
4. RFI and EMI Suppression-Provide Spectrum Analysis Test dB attenuation reports showing RFI filtering over specified frequencies.
 - 50KHz greater than 20dB
 - 150KHz greater than 40dB
 - 1MHz greater than 80dB
5. Diagnostic indicator lights located on the SPD housing shall provide alarm alert for each of the following conditions:
 - a. Loss of AC power.
 - b. Damage, malfunction in the SPD suppression circuits.
 - c. Improper AC electrical outlet wiring.
6. Standards Testing, Listing, Labeling and Certification Compliance, latest revisions:
 - a. IEEE 587 A and B compliance.
 - b. UL 1449 surge suppressers.
 - c. UL 1363 temporary power taps.

- d. UL 1283 electromagnetic interference filters.
- C. Rack Mounted SPD
 - 1. SPD units installed in equipment racks shall comply with all of the same Performance Requirements, except as follows.
 - a. EIA/TIA – Equipment rack mount style (19-inches or 24-inches as applicable).
 - b. Minimum of two front mounted receptacle outlets and not less than six rear mounted receptacle outlets.
 - c. 20-amp 120 volt 60Hz AC electric circuit rating, instead of 15-amp.

2.15 WIREWAY

- A. General:
 - 1. Unobstructed lay in type, metal wireway, fittings and connectors UL listed for use as wireway and auxiliary gutter. Length, elbows and "T-S" as shown on Drawings. Minimum cross-section size 4-inches by 4-inches, but not less than shown on the Drawings. Suitable for mounting in any position orientation.
- B. Construction:
 - 1. Minimum metal gauge shall not be less than 14 gages.
 - 2. Cover shall be hinged entire length of cover. Cover shall be held in the closed position with bolts and nuts.
 - 3. Provide spring nuts on all hardware fastener penetrations into the interior of the wireway to protect against wire insulation damage.
 - 4. The inside of 90-degree corners in the wireway shall be a 45-degree bevel.
 - 5. Grounding continuity between wireway sections and fittings shall be continuous the entire length of the wireway.
- C. Finish:
 - 1. Indoor non-raintight, rust inhibitor phosphatizing base coating and baked enamel finish, Manufacturer's standard color.
 - 2. Raintight outdoor-galvanized metal, with corrosion resistant phosphate primer and baked enamel finish, Manufacturer's standard color, NEMA 3R construction.
 - 3. All hardware shall be plated to prevent corrosion.

2.16 TRANSFORMERS

- A. General
 - 1. Provide dry type transformers constructed to meet Underwriters' Laboratories Specification UL 506 and tested in accordance with ANSI and NEMA Standards. Performance on transformers equal to or better than ANSI, NEMA, IEEE and CEC/NEC published criteria.
 - a. 60Hz AC line and load.
 - 2. UL Class 220°C insulation with maximum winding temperature rise of 150°C in 40°C ambient at 100% continuous rated capacity with overload capacity per ANSI C57.12 and C57.96 vacuum impregnated core and coil insulation. Transformer efficiency shall meet or exceed NEMA-TP1 (latest revision) Requirements.

3. Transformers shall be equipped with not less than five 2.5% full capacity voltage taps, two above and three below normal voltage. Line and load terminals shall be accessible, located behind removable front cover plate. Transformer connects shall terminate in "conductor-lugs" to match line side incoming and outgoing secondary side conductors, shall occur on a common (same) side of transformer on insulated supports.
 4. Provide wall mount and ceiling mount transformers support brackets, platforms and attachment structures for transformers.
 5. Dry type transformers shall meet or exceed NEMA TP-1 (latest revision), Class-1 efficiency levels and shall be marked as energy efficient for United States Department of Energy and Environmental Protection Agency DOE/EPA "Energy Star".
 6. Transformer windings shall be copper or aluminum.
 7. Electrostatic Shield: Provide full width, copper, 100% electrostatic shield (Faraday Shield), between line and load transformer windings, on each transformer phase. Shield shall be low impedance grounded to the transformer metal frame and shall attenuate common mode electrical noise 120dB at 1-500MHz range and transverse mode electrical noise, 30dB at 1-500MHz range. Average effective coupling capacitance of thirty picofarads between line and load sides.
 8. Connect transformers by one of the following methods:
 - a. Under floor conduit resulting in no rigid connections to transformer (provide ground strap for equipment ground).
 - b. Liquid tight flexible metal conduit (provide ground wire for equipment ground).
 - c. Pullbox or wireways from transformer which are isolated from transformer with an approved sound absorbing neoprene gasket (provide ground strap for equipment ground).
 9. The physical dimensions of the transformer shall not exceed the size shown on the Drawings.
 10. Transformer and transformer mounting shall be designed and tested and comply with install location seismic earthquake resistance seismic loads, typical for floor, wall and ceiling mount/suspended transformers. Bolt floor-mounted transformers to floor and mounting brackets, provide isolation rubber mounts, on each attachment contact location.
- B. Test Requirements:
1. The transformers shall be subjected to the following production tests:
 - a. Applied Potential
 - b. Induced Potential
 - c. No Load Loss.
 - d. Voltage Ratio.
 - e. Polarity
 - f. Continuity

2. The Manufacturer shall have performed the following additional tests on transformer units identical to the design type being supplied to this Specification. Proof of performance of these tests in the form of test data sheets shall be provided at the Time Shop Drawings are submitted for approval.
 - a. Sound Levels
 - b. Temperature
 - c. Full Load and 50% Load Losses for linear and nonlinear loads
 - d. Voltage Regulation
 - e. Impedance
- C. Transformer Housing
1. Metal, air cooled enclosure
 - a. Removable metal NEMA 1 enclosure, indoor location
 - b. Removable NEMA – 3R enclosures, outdoor locations, with vent shields.
 - c. Provide screen protected ventilation for all openings, including bottom of housing, to prevent accidental contact with internal components and prevent rodent/insect entrance.
 2. Manufacture’s rust inhibitor primer and standard finish paint.
 3. Removable lifting and skidding provisions.
 4. Provide wall mount and ceiling mount transformers support brackets, platforms and attachment structures for transformers.
- D. Sound Levels: Transformer sound levels, between no loads to full load, shall be guaranteed by the Manufacturer not to exceed the following values:
- | | |
|------------------|-------|
| 9kVA and below | 40dba |
| 10kVA to 50kVA | 45dba |
| 51kVA to 150kVA | 50dba |
| 151kVA to 300kVA | 55dba |
| 301kVA to 500kVA | 60dba |
- E. K-Rated Transformers
1. Transformers shall comply with UL-1561 and IEEE-519, shall all be rated K4, for harmonic content electrical loads, in accordance with UL-1561 and IEEE C57.110 (latest revision), unless noted other-wise with other-K Ratings on Drawings.
 2. The transformers shall be specially designed and manufactured for non-linear electrical load which cause harmonic current and voltage distortion, with 3rd, 5th, 7th, 9th and 15th harmonic current and volt-age distortion.
 3. Transformers, which are simply oversized larger than the specified kVA rating and then de-rated to the specified kVA rating to compensate for harmonic overloading, are not acceptable.
 4. Secondary neutral connections rated at 200% of rated secondary phase current.
 5. Transformers Manufactured by; Cutler Hammer; or General Electric; or Square D Co.; or Siemens.

- F. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements)
1. The complete transformer assembly; including housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested for wind loading for outdoor locations; earthquake seismic rated withstand for indoor and outdoor locations.
 2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
 3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.
 4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading as follows:
 - a. 110MPH-West Coast USA and Hawaii, per ASCE/SEI 7-10.
 5. Acceptance test seismic qualification of proposed equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
 6. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and reports shall be certified, signed and "stamped" by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

PART 3 - EXECUTION

3.01 GROUNDING (ADDITIONAL REQUIREMENTS)

- A. Grounding shall be executed in accordance with all applicable Codes and Regulations, both of the State of California and Local Authorities Having Jurisdiction.
- B. Each pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.
- C. The Maximum Resistance to Ground shall not exceed 5 ohms.

3.02 OUTLET AND JUNCTION BOXES

- A. General:
 1. Accurately place boxes and securely fastens to structural members. Where outlets are shown at same location but at different mounting heights, install outlets in one vertical line. Where outlets are shown at same location and mounting height, mount outlets as close together in a horizontal row as possible. Where the outlet boxes for switches and receptacles are shown at the same location and mounting height, mount in common outlet box with barriers between devices. Provide single piece multi-gang cover plate for close mounted outlet boxes. Where switches are shown on wall adjacent to hinge side of doors, box shall be installed to clear door when door is fully opened.

2. Flush mounted boxes shall be attached to not less than two parallel studs or structure members by means of metal supports. The supports shall span between and attach to the structure members.
 3. Boxes above accessible ceilings shall be attached to structural members. Where boxes are suspended, they shall be supported independently of conduit system by means of hanger rods and/or preformed steel channels. Boxes shall be supported independently of all piping, ductwork, equipment, ceiling hanger wires and suspended ceiling grid system.
 4. Surface mounted outlets shall be attached to concrete or masonry walls by means of expansion shields.
 5. Floor boxes shall be installed level with finish floor and within adjustable limits of floor ring. Where outlets are shown at same or adjacent location, use multi-gang boxes.
 - a. Provide cut-outs in the sub-floor assembly, to accept the recess depth of each electrical floor box. Provide added "fire-proof" applications on the bottom of each floor box location extending through the sub-floor. The "fire-proof" application shall be equal to the floor fire-assembly withstand rating.
 - b. Poke-thru floor outlets, core drill floor for installation of poke-thru. Install "split-box" in the ceiling space of the floor below. If the ceiling space of the floor below is not accessible ceiling type (lift-out), then provide 12-inches round removable fire-rated stainless steel access panel and trim-ring in the finish ceiling for hand-access to poke-thru "split-box" above the ceiling.
 6. Outlet Box Horizontal and Vertical Separation: Outlet boxes and device outlet rings installed flush in walls shall be horizontally and vertically separated by not less than 24-inches (edge of box to edge of box) from device outlet boxes and rings in common wall surfaces located on the opposite (back) side of the same wall.
 - a. Where the separation cannot be maintained, provide a solid backing behind and completely enclosing each outlet box.
 - b. The backing shall extend the width of the wall cavity (i.e., between "studs" or masonry cells) behind the box and 12-inches above and below the outlet box center-line, completely enclosing the outlet box.
 - c. The backing shall consist of the following:
 - 1) $\frac{5}{8}$ -inch thick gypsum board anchored in place for "stud" wall construction.
 - 2) Solid "mortar" to completely fill the outlet box "cell" behind the box in masonry construction.
 7. Provide metal outlet box for each device. Install devices in metal outlet boxes. Typical for all wiring devices including, switches, receptacles, line voltage devices, and low voltage/signal system devices.
- B. Fire Wrap:
1. In fire rated walls and ceilings provide fire rated "box-wrap" around the outside of each outlet box placed in fire rated wall or ceiling. Install the fire wrap on exterior of box inside the wall or ceiling, to maintain the fire rating of wall or ceiling with the installed outlet boxes.

3.03 SWITCHES AND RECEPTACLES-DEVICES

A. General

1. Provide outlet boxes for all devices, switches, receptacles, both line-voltage and low-voltage.
2. Devices installed in wireways shall be installed flush in wireway assembly.
3. Install and screw attach devices into outlet boxes and wireways.
4. Provide ground circuit connections to all devices.
5. Provide branch circuit connections to all devices.
6. Provide testing and commissioning for proper operation and phase/ground connectors.
 - a. Test each GFCI devices and Arc-Fault devices after installation and circuit connection is complete.
 - b. Test all devices for correct polarity and proper electrical energization.
 - c. Test On-Off operation of automatically controlled outlets and receptacles.
7. Install and adjust all coverplates to be flush and level, with correct device and circuit identification.
8. Where one or more device occurs at the proximity with other similar devices, all of the devices shall be "granged" under one common coverplate as follows:
 - a. Duplex convenience receptacles with other proximity (within 18-inches) duplex convenience receptacles.
 - b. Lighting control switches not exceeding 20-amp switch rating with other proximity (within 18-inches) similar switches.

B. Line-voltage Plug-In Type Receptacle Installation Orientation:

1. The "ground-pin" shall face "up" at the receptacle top location (double duplex) 4-plex, individual and vertically mounted individual duplex receptacles.
2. The "neutral-blade" shall face "up" at the receptacle top location on horizontally mounted duplex receptacles.

3.04 CONCRETE WORK

A. Form:

1. Space forms properly with spreaders and securely tie together. Do not use twisted wire form ties. Keep forms wet to prevent joints from opening up before concrete is placed. Replace improper construction as directed. Do not use wood inside forms.
2. Build in and set all anchors, dowels, bolts, sleeves, iron frames, expansion joints and other materials required for the Electrical Work. Place all items carefully, true, straight, plumb, and even.
3. Carefully remove all exposed forms. Cut nails and tie wires below face of concrete and fill all holes. Rubbish will not be allowed to remain in, under, or around concrete.

- #### B. Mixing: Use batch machine mixer of approved type. After ingredients are in mixer, mix for at least 1½-minutes.

- C. Transit Mixing: In lieu of mixing at site, transit mixing may be used if rate of delivery, haul time, mixing time, and hopper capacity is such that concrete delivered will be placed in forms within 90-minutes from time of introduction of cement and water to mixer.
- D. Placing of Concrete
 - 1. Before placing concrete, remove wood, rubbish, vegetable matter and loose material from inside forms. Thoroughly wet down wood forms to close joints.
 - 2. Clean reinforcement; remove paint, loose rust, scale and foreign material. Bars with bends not called for will be rejected. Hold securely in place to prevent displacement. Lap bar splices 24-diameters, min; lap fabric one mesh min. Tie intersections, corners, splices with 16-gallon annealed wire, or as otherwise called for.
 - 3. Place concrete immediately after mixing. Do not use concrete that has begun to set; no tempering will be allowed. If chuting is used, avoid segregation. In placing new concrete against existing concrete, use bonding agent per Manufacturer's directions.
 - 4. Give careful and thorough attention to curing of concrete. Keep concrete and forms wet for a minimum of 10-days, after placing concrete.
- E. Concrete Finish
 - 1. Finish of Exposed Concrete: Horizontal surfaces, steel troweled monolithic finish; vertical surfaces, smooth and free of fins, holes, projection, etc.
 - 2. Exposed lighting pole bases shall be filled and sack finished to a smooth finish.
 - 3. Remove concrete pour-forms.

3.05 SURGE PROTECTION DEVICE INSTALLATION (SPD)

- A. Direct Connect SPD Installation
 - 1. Install unit cabinet to insure a maximum connected circuit length of less than 5-feet from the equipment the surge protection unit is connected to, approximately plus 48-inches on wall.
 - 2. Alternately, factory install SPD unit directly into respective equipment, instead of remote from equipment. Install SPD inside respective switchgear, switchboards, distribution panels, panelboards, etc.
 - 3. Connect between surge protection unit and supply equipment with not less than 1.25-inch conduit containing 5#4 AWG, copper conductor, 600 volt THHN/THWN insulation, connection circuit.
 - 4. Provide a subfeed overcurrent protective device in the respective panel or switchboard to supply the SPD connection circuit, whether or not shown on the Drawings. The protective subfeed device shall be a thermal magnetic circuit breaker rated not less than 30-amp 3-pole or a safety switch and fuse unit rated not less than 60-amp 3-pole, voltage and short circuit fault interrupting class to match the respective circuit voltage.
 - 5. Connect surge protection unit to main building ground bus or electric distribution equipment ground bus (whichever is closer distance), with 1.25-inch conduit - 1#4 AWG copper conductor 600 volt, THHN/THWN insulation.
- B. Plug-In Type SPD
 - 1. Install in respective equipment racks.

2. Install at respective workstation locations, cabinets and furniture.
 3. Connect to respective equipment and wall electrical outlets.
- C. Install, Connect, and Test each SPD Unit in Accordance with Manufacturer's recommendations.

3.06 WIREWAY INSTALLATION

Wireway hangers shall provide clamp type, hanger rod type, direct bolted bracket type from ceiling or walls as indicated on the Drawings and required for field installation locations. Supports shall be installed a minimum of 5-feet on center.

END OF SECTION 26 05 01

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**SECTION 26 05 05
ELECTRICAL DEMOLITION**

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with demolition, furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.

1.02 GENERAL SUMMARY OF DEMOLITION WORK

- A. The Specifications and Drawings are intended to cover a complete installation. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.
- B. Refer to the Drawings and Shop Drawings of other trades for Additional Demolition Requirements which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.
- C. It is the Contractor's responsibility to visit the site and become thoroughly familiar with all features of the building and site which may affect the proper performance of this work.
- D. Portions of these Plans have been derived from information taken from original Electrical Plans. The intent of the Drawing and Specifications is to provide a complete and operable system.

1.03 LOCATIONS OF EQUIPMENT

- A. The Drawings indicate diagrammatically the locations or arrangements of conduit runs, outlets, equipment, etc. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.
- B. In the event changes in the locations or arrangements are necessary, due to existing conditions in the building construction or arrangement of furnishings or equipment, such changes shall be made without cost, providing the change is ordered before the work directly connected to same is installed and no extra materials are required.

1.04 UNDERGROUND DETECTION SERVICES

- A. Services shall be provided utilizing the latest detection equipment available. Services available from Underground Technology Incorporated, phone (800) 366-7801. Services shall be performed by a company regularly engaged in the business of Underground Detection for the past 5-years.

- B. Prior to excavation the following work shall be performed:
1. Obtain all available Record Drawings of the site from the Owner.
 2. Obtain vellums of Civil Site Drawings for use in indicating existing underground systems.
 3. Contractor to mark trenching locations and indicate width and depth.
 4. Locate, by way of horizontal control, existing detectable sub-grade power conduits, fire alarm, communication, signal, sewer, water, gas, storm drain and irrigation lines in the affected areas.
 5. Arrange and meet with the Owner's Representative to review existing underground conditions.
 6. Exercise extreme caution in excavating and trenching on this site to avoid existing underground utilities, and to prevent hazard to personnel and/or damage to existing underground utilities or structures. These Drawings and Specifications do not include necessary components for construction safety, which is the responsibility of the Contractor.
 7. Repair/replace to the satisfaction of the Owner, any work damaged that was identified in the Record Drawings provided, noted by the Owner's Representative, or identified by the Underground Detection Services performed.
 8. The Contractor shall contact Underground Service Alert of Southern California, (800) 422-4133, at least 48 hours prior to excavation, and shall not excavate until verification has been received and that public utilities serving the site have located and marked.
- C. The locations of existing underground utilities, where shown on Drawings, are shown diagrammatically and have not been independently verified by the Owner or its Representative. The Architect and his Consulting Engineers are not responsible for the location of underground utilities or structures, whether or not shown or detailed and installed under this or any other Contracts.

1.05 SUBMITTALS

- A. Schedule: Submit proposed outage schedule.
- B. Provide a sequence of demolition to insure uninterrupted use of occupied facilities, which are to remain in operation during the Contract period.

1.06 CUTTING AND PATCHING

Perform cutting and patching of the construction work which may be required for the proper demolition of the electrical work. Patching shall be of the same material, thickness, workmanship and finish as existing and accurately match surrounding work to the satisfaction of the Architect. Cutting of Structural members shall not be done without notifying the Architect and obtaining structural approval.

1.07 ASBESTOS, POLYCHLORINATED BIPHENYL (PCB) OR HAZARDOUS WASTE:

It is understood and agreed that this Contract does not contemplate the handling of asbestos, PCB or any hazardous waste material. If asbestos, PCB or any hazardous waste material is encountered, notify the Owner immediately. Do not disturb, handle, or attempt to remove.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 -EXECUTION

3.01 THE SCOPE OF THE DEMOLITION WORK SHALL INCLUDE ALL LABOR, MATERIALS, SERVICES, AND EQUIPMENT REQUIRED TO PROVIDE THE SPECIFIED NEW WORK. THIS WORK INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:

- A. Exercise extreme caution in excavating and trenching on this site to avoid existing ducts, piping, conduits, and utilities.
- B. Refer to Architectural Drawings for ceiling removal locations. Except as noted otherwise, disconnect and remove all existing ceiling mounted lighting fixtures, smoke heat detectors, outlets and junction boxes, speakers, exposed wiring, raceways, and all other electrical devices and hardware attached to the ceiling structure.
- C. Refer to Architectural Drawings for wall removal locations. Except as noted otherwise, disconnect and remove all existing wall mounted receptacles, data outlets, telephone outlets, fire alarm devices, security devices, wiring, raceways, outlet boxes and all other electrical devices and hardware attached to the walls.
- D. All conduits rising from below grade to areas where partitions, walls, and/or other construction entities are indicated as being removed shall be cut to below finish floor, capped, and abandoned. Provide patching as required.
- E. Where new partitions or other construction will cover existing outlets or fixtures making them inaccessible, move these outlets and conduits as required, or make other provisions so that the outlets will remain accessible and operational.
- F. Relocate existing wiring, cabling, conduits and outlets from areas where plenums or roof openings are being provided.
- G. Where existing walls and ceilings are to remain, provide blank covers or plates for outlets where fixtures or devices are removed under this Contract. Prime blank plates and paint to match surrounding area.
- H. All existing panelboards, signal terminal cabinets, equipment racks, cabinets, disconnect switches; pullboxes, etc. shall remain unless noted otherwise on Plans.
- I. Disconnect and remove all existing signal system conduits, surface raceways wiring and cabling for tele-phone, data network, public address speakers, audiovisual systems, projectors, clocks, and fire alarm devices, intrusion detection device, television outlets unless noted otherwise on Plans.
- J. Seal all abandoned floor penetrations in manner acceptable to the Architect.
- K. Repair and/or replace roofing materials, ceiling tiles, fixtures, etc. damaged by this construction.
- L. Openings in existing fire rated partitions barriers, floors, ceiling etc. shall be sealed tight with UL and NEPA fire stop material equal to fire rating of the penetrated surface.
- M. Install all new conduits concealed in walls or furred ceilings.
- N. Remove all exposed conduit, wire, outlets, disconnect switches and electrical mounting hardware for equipment removed.

- O. Provide weatherproof caps on abandoned conduits penetrating the roof. Repair roofing damaged by removal of existing electrical equipment.
- P. For clarity, miscellaneous equipment, and raceways not related to Project are not shown.
- Q. All dimensions and locations of equipment are approximate. Contractor shall field verify all dimensions.
- R. Immediately notify the On-Site Inspector and Owner of any damage to new or existing work.
- S. Repair/replace all damaged or defective work, materials, and equipment to the Architects satisfaction.
- T. All removed materials and equipment, which in the opinion of Architect are salvageable, shall remain the property of the Owner. Deliver such salvaged materials and equipment on premises as directed, neatly pile or store them and Protect from damage. Where materials and equipment have been removed and not replaced the exposed surface shall be painted to match surrounding surfaces. Do not reuse materials and equipment, unless specifically indicated on Plans or specified. Remove from premises and dispose of all materials considered by Architect to be scrap.

END OF SECTION 26 05 05
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SECTION 26 05 30
CONDUIT AND WIRE

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit product data sheets for all wire, supports, conduit, fittings and splicing materials.
- B. Submit material list for all conduit and conduit fittings.
- C. Submit details and structural engineering calculations for conduit support systems.

PART 2 - PRODUCTS

2.01 CONDUIT

- A. General
1. The interior surfaces of conduits and fittings shall be continuous and smooth, with a constant interior diameter. Conduits and conduit fittings shall provide conductor raceways of fully enclosed circular cross section. The interior surfaces of conduits and fittings shall be without ridges, burrs irregularities or obstructions. Conduits and fittings of the same type shall be of the same uniform weight and thickness.
 2. Type of conduit, type of conduit fittings and conduit supports shall be suitable for the conditions of use and the conditions of location of installation, based on the Manufacturer's recommendations and based on applicable Codes.
 3. All fittings for metal conduit shall be suitable for use as a grounding means, pursuant to the applicable Code Requirements. All metal conduit and metal conduit fittings shall provide 3 second duration ground fault current carrying ratings, when installed and connected to the respective conduit, as follows:
 - a. RMC and EMT conduit fittings.
 - 1) 0.5 inch through 1.5 inch conduit/fitting size - 10,000 amp RMS.
 - 2) 2.0 inch and larger conduit/fitting size - 20,000 amp RMS.
 - b. FMC and LTFMC Conduit Fittings
 - 1) 0.5 inch through 1.25-inch conduit/fitting size-1,000 amp RMS (without external bonding jumper).
 - 2) 1.5 inch through 4.0-inch fitting size-10,000 amp RMS with bonding jumper.

4. Protective corrosion resistant finish for metal conduit fabricated from steel and metal conduit fittings fabricated from steel, shall be as follows:
 - a. Clean all metal surfaces (including metal threads) with acid bath “pickle” prior to coating, to remove dirt, oil and prepare surfaces for galvanizing.
 - b. Hot-dip galvanized zinc coating on all interior and exterior steel surfaces. Minimum finish zinc coating thickness shall not be less than 0.002 inches.
 - c. Threads shall be hot-dip zinc coated after machine fabrication.
 - d. Exterior metal surfaces shall be finished with clear organic polymer topcoat layer, after galvanizing.
 - e. The inner metal surfaces of conduit fittings shall be finished with a lubricating topcoat after galvanizing, to facilitate conductor pulling through the conduit/fitting.
 5. Threads for metal conduit and metal conduit fittings shall be taper-pipe-thread, National Pipe Standards (NPS) and shall comply with ANSI-B1.20.1.
 6. Metal conduit termination connector fittings shall be provided with a Manufacturer installed, insulating throat bushing inside the fitting. The bushing shall protect the wire conductor insulation from cutting, nicks and abrasion during conductor installation and electrical load “cycling” after installation is complete. The bushing shall comply with UL 94V-0 flammability.
 7. Provide conduit bonding/grounding jumper from metal enclosures with “concentric ring” knockouts, to positively ground/bond each respective conduit(s) to the metal enclosure.
 8. Metal conduit fittings connecting to PVC coated metal conduit shall be PVC coated to match the conduit.
 9. The conduit and fittings shall be watertight and airtight without cracks and pinholes.
- B. Rigid Metal Conduit (RMC)
1. Rigid metal, round tubing, machine threaded at both ends.
 - a. The conduit and conduit fittings shall comply with the Requirements for an equipment grounding conductor, pursuant to applicable Codes.
 2. RMC raceway types shall be as follows:
 - a. Rigid Galvanized Steel conduit (RGS), minimum yield strength shall be 35,000 PSI. Shall comply with NEMA Standard 5-19 (latest revision); ANSI C80.1 and ANSI-C80.4 (latest revision); UL 514-B and UL 6 (latest revisions); National Pipe Standard Specification (latest revision).
 - b. Intermediate steel Conduit (IMC). Shall comply with NEMA Standard 5-19 (latest revision) ANSI-C80.6 (latest revision); UL 2142 (latest revision).
 3. RMC fittings:
 - a. Fittings shall be compatible with RGS and IMC.
 - b. Fittings shall be rated “liquid tight”.
 - c. Fittings imbedded in concrete shall be rated “liquid tight” and “concrete tight”.
 - d. Connectors and couplings for terminating, connecting and coupling to RMC conduit shall be threaded metal.
 - e. Fittings shall comply with ANSI C80.4 and ANSI C33-84 (latest revision); NEMA FB1 (latest revision); UL 514 (latest revision).

- f. Conduit seal fittings:
 - 1) Conduit seals shall prevent the passage of gasses, liquids and vapors past the location of the seal installation in the conduit.
 - 2) Conduit seals shall be suitable for installation in both vertical and horizontal conduit locations.
 - 3) Conduit seals shall be visible and accessible for inspection after installation is complete.
 - 4) Conduit seals shall be rated for the following locations:
 - a) Wet locations
 - b) Classified hazardous location materials NEC Class 1 Division 1.
 - c) Temperature ranges from 0 degrees centigrade through 90 degrees centigrade.
 - 5) Conduit seals, sealing compound and sealing compound dam shall be the products of the same Manufacturer.
- 4. RMC fittings as manufactured by:
 - a. For threaded enclosure, termination connection.
 - 1) Thomas & Betts – 106 Series bonding locknut, 5302 Series sealing ring with stainless steel retainer.
 - b. For non-threaded enclosure, termination connector.
 - 1) Thomas & Betts – 370 Series watertight threaded sealing hub, 106 Series threaded bonding lock nut, Sta-Con Series enclosure bonding jumper and 3870 Series threaded ground bushing.
 - 2) Emerson-OZ/Gedney-CHMT/CHT watertight threaded hub with bonding lock-nut and GH50G Series enclosure bonding jumper.
 - c. For RMC to RMC conduit-to-conduit coupling
 - 1) Thomas & Betts/Erickson - 674 (threaded) Series
 - 2) Emerson-OZ/Gedney Type TPC (threaded) Series
 - 3) Threaded RMC conduit couplings, product of the same Manufacturer as the RMC conduit.
 - d. For RMC Conduit Seals
 - 1) Emerson-OZ/Gedney-EYA and EYAM (threaded) Series
 - 2) Appleton-EYF and EYM (threaded) Series
- C. Electrical Metallic Tubing (EMT)
 - 1. Rigid metal round tubing, “thin wall” steel construction, with non-threaded ends.
 - a. The conduit and conduit fittings shall comply with the Requirements for an equipment grounding conductor pursuant to applicable Codes.
 - b. The conduit shall be watertight and airtight without cracks and pinholes.
 - 2. EMT shall be allowed for conduit size ranges from 0.5-inch through 4.0-inches.
 - 3. Comply with ANSI C80.3, C80.4, and ANSI C33.98 (latest revisions); UL 594 and UL 797 (latest revisions); CEC Section 12500 (latest revision).
 - 4. EMT fittings:
 - a. Connectors and couplings for terminating, connecting and coupling to EMT conduit shall be non-threaded steel fabrication.

- b. EMT termination connector fittings shall be as follows:
 - 1) Set screw type “concrete tight” when installed in dry interior locations.
 - 2) Compression types “raintight” and “concrete tight” when installed in wet or damp locations, outdoors and in concrete or masonry construction.
 - c. Fittings shall comply with ANSI C33.84 (latest revision); UL 514 (latest revision); NEMA FB-1.
5. EMT fittings as manufactured by:
- a. For threaded and non-threaded enclosure, termination connector
 - 1) Thomas & Betts-TC721A (set screw type) Series (with locknuts).
 - 2) Emerson-OZ/Gedney-TC500I (set screw type) Series (with locknuts).
 - 3) Thomas & Betts-5123 (compression type) Series (with two locknuts).
 - 4) Emerson-OZ/Gedney-TC600I (compression type) Series (with locknut).
 - 5) Thomas & Betts-4240 (compression type) Series (90 degree angle with locknut).
 - 6) Emerson-OZ/Gedney-TWL (compression type) Series (90 degree angle with locknut).
 - b. For EMT to EMT conduit-to-conduit coupling:
 - 1) Thomas & Betts-TK121A (set screw type) Series (with locknut).
 - 2) Emerson-OZ/Gedney-5000 (set screw type) Series (with locknut).
 - 3) Thomas & Betts-5120 (compression type) Series.
 - 4) Emerson-OZ/Gedney-TC600 (compression type) Series.
 - c. For EMT to RMC conduit to conduit combination coupling:
 - 1) Thomas & Betts-HT221 (set screw type) Series.
 - 2) Emerson-OZ/Gedney-ESR (set screw type) Series.
 - 3) Thomas & Betts-530 (compression type) Series.
 - 4) Emerson-OZ/Gedney-ETR (compression type) Series.
- D. Flexible Metal Conduit (FMC)
- 1. Round flexible conduit, fabricated from a single continuous steel strip. The steel shall be factory formed into continuous interlocking convolutions to form a complete lock between steel strips and provide raceway flexibility.
 - 2. Metal to metal grounding contact shall be maintained throughout the length of the FMC conduit.
 - 3. FMC shall be allowed for conduit size ranges from 0.5 inch through 4.0-inches.
 - 4. FMC shall comply with ANSI-C.33.84 and ANSI C33.92; NEMA FB-1; CEC 12-1100.
 - 5. FMC Fittings
 - a. FMC fittings shall be malleable iron construction or steel construction.
 - b. Fitting shall automatically cause the FMC raceway throat opening to be centered with respect to the fitting throat opening.
 - c. Straight and angled connector termination fittings shall be threaded on one end and shall include a threaded locknut, suitable for connection to threaded and unthreaded enclosures.
 - d. The attachment of the fittings to FMC shall be angled saddle type, to engage and interlock with the FMC spiral groove, and shall be unaffected by vibration. Direct bearing screw type fittings shall not be used.

- e. Direct FMC conduit-to-FMC conduit coupling of FMC shall not be permitted.
 - f. Shall comply with ANSI C33.9, and ANSI C33.92 (latest revision); NEMA FB1 (latest revision); UL 514.
6. FMC fittings as manufactured by:
- a. Straight Termination Connectors 45 and 90 Degree Angle Connectors
 Thomas & Betts-3110 Series (w/ locknut) Thomas & Betts-3130 Series (w/ locknut)
 - b. FMC to EMT conduit combination coupling: Thomas & Betts 503TB Series.
- E. Liquid Tight Flexible Metal Conduit (LTFMC)
1. The metal conduit core of LTFMC shall comply with the same Requirements as FMC conduit, with the addition of a thermoplastic exterior flexible jacket over the metal core.
 2. The exterior jacket shall be positively locked to the metal core to prevent jacket "sleeving".
 3. The LTFMC shall be rated for installation and operating service temperatures of between minus 20 degrees centigrade through plus 90 degrees centigrade.
 4. The LTFMC jacket shall be suitable for continuous exposure to sunlight, rainwater, water vapor, mineral oils and liquid solvents, without penetrating into the conduit and without deteriorating the jacket.
 5. LTFMC sizes from 0.5-inch through 1.25-inch shall include an additional internal ground conductor, fabricated by the Manufacturer, as an integral part of the conduit core.
 6. Direct LTFMC conduit-to-LTFMC conduit coupling of LTFMC shall not be permitted.
 7. LTFMC shall be allowed for conduit size ranges from 0.5-inch through 4.0-inches.
 8. In addition to the Requirements for FMC conduit, LTFMC shall also comply with ANSI C-33.84 (latest revision); NEMA-FB1 (latest revision); CEC 12-1400 (latest revision).
 9. LTFMC fittings
 - a. Fittings shall include an external mechanical ground/bond wire connector.
 - b. The attachment of the fitting to LTFMC shall be threaded compression type onto the conduit core with locknut and liquid tight jacket compression seal. The fitting shall automatically prevent "sleeving" of the jacket.
 - c. Straight and angled termination connector fittings shall be threaded on one end and shall include locknut suitable for connection to threaded and unthreaded enclosures.
 10. LTFMC fittings as manufactured by:
 - a. Termination connector fittings:

<u>Straight</u>	<u>45 and 90 Degree Angle Connectors</u>
1) Thomas & Betts-5331 GR Series.	Thomas & Betts-5341GR & 5351GR Series.
2) Appleton-STB & STN-L Series for use with preformed "knockouts".	Appleton-STB-L Series; STN-L Series for use with preformed "knockouts".
3) Emerson- OZ/Gedney-4Q Series.	Emerson-OZ/Gedney-4Q Series
 - b. LTFMC to RMC conduit to conduit combination coupling fittings:
 - 1) Thomas & Betts-5271 GR Series.
 - 2) Emerson-OZ/Gedney-4Q Series

F. Rigid Non Metallic Conduit (RNMC)

1. General

- a. Conduit and fittings shall be 90 degree centigrade conductor rated. Fabricated from homogeneous material, free from visible cracks, holes or foreign inclusions, with integral "end-bell". The conduit and conduit fittings shall be watertight and airtight.
- b. Conduit, conduit fittings and conduit fitting assembly "solvent cement" shall all be the product of the same Manufacturer. Conduit fittings shall be solvent cement welded watertight.
- c. Conduit and fittings shall be identified with legible markings showing ratings, size and Manufacturers name.
- d. RNMC and fitting shall be corrosion resistant, watertight.
- e. Conduit shall be suitable for conductor operating temperatures from minus 20 degrees centigrade to 90 degrees centigrade.
- f. RNMC shall comply with NEMA TC-2 (PVC 40 conduit, latest revision) NEMA TC-6 (EB conduit latest revision) and NEMA TC-3 (fittings, latest revision); UL 514 and UL 651 (latest revision).

2. Polyvinyl Chloride (PVC)-RNMC

- a. PVC-Schedule 40 heavy wall construction.
- b. PVC-Schedule 80 extra heavy wall construction.
- c. PVC-Type EB.

3. RNMC fittings connecting to metallic raceways shall be provided with a ground/bond jumper connection.

G. Combi-Duct

1. Rigid nonmetallic conduit combining a continuous linear outer raceway (duct) with factory installed (inside the outer duct) multiple, segregated inner raceway (ducts). Rigid, Schedule 40 PVC construction. Shall be modular lengths of 20-feet for each duct segment.
2. The conduit shall be suitable for use with signal/telecommunications, fiber optic, telephone and computer/data circuits, operating at 100 volts or less, UL listed and labeled.
3. Outer Duct, outer enclosing Schedule-40 PVC duct size. The outer enclosing duct shall be 4.2-inches inside nominal duct diameter and 4.5-inches outer duct nominal diameter.
4. Inner-ducts (contained inside the enclosing outer duct), non-metallic SDR-19 or Type-C/ CAO-8546:
 - Triple Combi-Duct
 - a. Quantity of three continuous round rigid inner linear ducts, nominal size inside diameter 1.5-inch for each inner duct.
 - Quad Combi-Duct
 - b. Quantity of four continuous round rigid inner linear ducts, nominal size inside diameter 1.19-inch for each inner duct.
5. Manufacturer's standard bends and offsets, minimum 72-inches radius.
6. Combi-duct and combi-duct fittings shall be airtight and watertight. Approved for direct burial in earth and approved for encasement in concrete.

7. As manufactured by Carlon # Multi-Guard/Multi-Cell Series; American Pipe and Plastic (AMTEL) #Multi-Bore Series; or equal.
- H. Expansion Joint, Deflection Joint and Seismic Joint Conduit Fittings
1. Expansion Conduit Fitting – Fitting shall provide for a minimum of 2-inches straight line movement between two connecting conduits in each direction (total 4-inches conduit expansion and Contraction) parallel to the respective conduit lengths. Fitting shall be watertight.
 2. Deflection Conduit Fitting – Fitting shall provide for a minimum of 30 degrees angular deflection movement (“Shear” deflection) between two connecting conduits, in any direction perpendicular to the length of the respective conduits. Fitting shall be watertight.
 3. Combination Expansion/Deflection Conduit Fitting – Fitting shall provide the combined “expansion” and “deflection” movement capacity between two connecting conduits as described for separate “expansion” and “Deflection” conduit fittings. Fitting shall be approved for installation concealed in both masonry/concrete construction and exposed non-masonry/concrete construction. Fitting shall be watertight.
 4. Fittings shall comply with UL.
 5. Fittings as manufactured by:
 - a. Conduit expansion fittings exposed or concealed locations as manufactured by:
 - 1) Emerson-OZ/Gedney – AXB-8 Series for RMC conduit.
 - 2) Emerson-OZ/Gedney - TX Series for EMT conduit.
 - 3) Appleton – AXB or XJ8 Series for RMC conduit and EMT conduits. Provide RMC to EMT combination conduit coupling fittings for each end of the expansion fitting.
 - b. Combination expansion/deflection conduit fittings exposed or concealed conduit locations as manufactured by:
 - 1) Emerson-OZ/Gedney - AXDX Series for RMC conduit.
 - 2) Emerson-OZ/Gedney - AXDX Series for EMT conduit.
 - 3) Appleton-DX Series for RMC conduit.
 - 4) Provide RMC to EMT combination conduit coupling fittings for each end of the expansion/deflection fitting.
 - c. Conduit expansion/deflection fittings for FMC and LTFMC conduit.
 - 1) Provide a minimum of 12-inches of “slack” LTFMC in each FMC or LTFMC conduit at building and structure seismic or expansion joint conduit crossings.
 - 2) Note: Each FMC “slack” expansion/deflection location, shall be considered as not less than a 90 degree conduit bend location, for compliance with the maximum quantity of conduit bends allowed in a raceway.
 6. Conduit fitting bonding jumper:
 - a. The grounding/bonding path of metal conduit shall be maintained by the fitting.
 - b. Provide a bonding jumper at each expansion, deflection and combination expansion deflection conduit fitting.
 - c. The jumper shall be a bare flexible copper “braid”. The copper braid electrical current carrying capacity shall be equal to the metal conduit.

- d. Provide a factory terminated ground clamp on each end of the braid with adjusting steel conduit grounding clamps and connect to each respective conduit end.
 - e. The jumper braid length shall be 8-inches longer than the respective conduit fitting.
 - f. Bonding jumper for FMC and EMT fittings as manufactured by:
 - 1) Emerson-OZ/Gedney – BJ and BJE Series
 - 2) Appleton – BJ/XJ Series
- I. Conduit Bodies Conduit Fitting
- 1. Conduit bodies shall provide conductor access with a removable conduit body cover and wiring area enclosed in metal housing. The conduit body shall facilitate pulling conductors.
 - 2. In-line form “C” conduit bodies shall be prohibited.
 - 3. The interior space “length” of 90 degree “elbow” conduit bodies shall not be less than six times the diameter size of the largest conduit connecting to the conduit body.
 - 4. Conduit body covers shall be removable, gasketed; watertight “domed” metal covers “Mogul-Type” with threaded screw attachment to the conduit body.
 - 5. Lubricated, reusable, wire roller guards inside the conduit body shall protect wire from insulation damage during wire “pulling”.
 - 6. Conduit body fittings shall comply with UL 514.
 - 7. Conduit bodies as manufactured by:
 - a. For RMC Conduit
 - 1) Hubbell/Killark – LB/Mogul (90-degree elbow) Series – threaded body.
 - 2) Emerson-OZ/Gedney - LB 6X/Mogul (90 degree elbow) Series - threaded body.
 - 3) Appleton – NEC6X-LB/Mogul (90 degree elbow) Series - threaded body.
 - b. For EMT Conduit
 - 1) Same as for RMC conduit. Provide EMT to RMC conduit combination coupling fitting for each outlet body connection.

2.02 PVC COATING

- A. PVC coatings shall be provided as described for specified metal products.
- B. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.
- C. The adhesion of the PVC coating to the coated metal shall exceed the strength of the coating itself, based on 0.5-inch “strip-pull” test.
- D. Uniform coating thickness shall be continuous without “breaks” or “pinholes” and shall not be less than the following:
 - 1. Exterior metal surfaces, 40-millimeter coating thickness.
 - 2. Interior metal surfaces, 10-millimeter PVC or urethane coating thickness (i.e. interior of conduits, interior of conduit fittings etc.).

2.03 CONDUIT SUPPORTS

- A. General
 - 1. Conduit Supports, hangers and fasteners for metal conduit shall be steel, hot dip zinc galvanized.

2. Conduit supports, hangers and fasteners for PVC coated conduit shall be PVC coated to match the conduit PVC coating.
 3. Threaded hardware shall be continuous, free running threads.
 4. Conduit support systems, including support channels, pipe clamps, braces, anchors, hardware, fasteners, shall be sized to support the full capacity circuit conductors weight, plus the installed conduit weight, plus the conduit fitting weight and support hardware weight, plus a 300% additional weight capacity safety factor.
 5. Provide lock washer at each "bolted"/threaded connection.
 6. Conduit supports, fasteners, channels, braces, hardware, anchors, pipe clamps, and hangers as manufactured by Unistrut or Kindorf.
 7. Supports shall be free of "BURRS" and sharp edges.
 8. Metal supports cut in the field shall be zinc galvanized after cutting to prevent rust.
- B. Conduit Hangers
1. Threaded steel hanger rods.
 - a. Hanger rods smaller than 0.375-inches in diameter shall not be used for support of individual conduits.
 - b. Hanger rods smaller than 0.5-inches in diameter shall not be used for support of multiple conduits.
 2. Conduit hanger wires shall be not less than 12-gauge steel.
 3. Conduit hangers shall attach to structure fasteners with steel "Clevis" or "Swing" hangers and shall provide a minimum of 45 degrees of angular movement in any direction at the point of the conduit hanger attachment to the structure fasteners.
 4. Conduits individually suspended by conduit hangers shall fasten to the respective hangers with "Clevis" type pipe hangers. The pipe hangers shall be steel, adjustable to fit conduit size and shall completely enclose the conduit circumference.
- C. Conduit Support Channels
1. "C" channels shall be factory preformed with a minimum 12 gauge thickness metal. The channel shall be factory "punched" with regularly spaced slotted holes for fastener attachments along the length of the channel.
 2. The "C" channel shall not deflect more than 0.1 inch between channel supports at maximum installed design load, including required safety factor.
 3. Channels shall comply with ANSI-1008 (latest revision) and ASTM-A569 latest revision).
 4. Channels shall provide "turned lips" at longitudinal edges to hold (lock-in) fasteners.
 5. Conduit support channels suspended from conduit hangers shall attach to conduit hangers with treaded connections. Provide a minimum of two hangers (trapeze style) connected to each channel.
 6. Non-suspended conduit support channels shall connect to structure fasteners with threaded connectors.

D. Fasteners, Seismic Earthquake Rated

1. Channel fasteners:
 - a. Channel fasteners shall “prelocate” and lock into the channel “turned lips” and channel “walls”.
 - b. A separate metal strap shall “tie” each conduit to each channel with conduit channel fasteners.
2. Structure fasteners:
 - a. Structure fasteners for wall and floor mounted conduit attachments shall attach to existing masonry and concrete structures with structure fasteners using drilled, mechanical, expansion shield anchors.
 - b. Structure fasteners for wall and floor mounted conduit attachments shall attach to new masonry and concrete structures with structure fasteners using steel threaded inserts precast into the structures.
 - c. Structure fasteners shall center the support load above or below the beam flanges and reduce torsion-rotation forces exerted on the structural beam. Attach to steel structural members with “swing-beam clamps”, with set-locking screw structure fasteners.
 - 1) Beam clamps shall include integral safety rod, strap or “J”-hook to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
 - 2) Or double-ended beam clamp to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
 - d. Structure fasteners for wall and floor mounted conduit attachments shall attach to wood structural members with flush “through-bolted” wood beam/ wood framing stud structure fasteners.
 - e. Structure fasteners for wall mounted conduit attachments shall attach to steel framing studs and steel structural elements with spot welded steel structure fasteners or drilled and bolted structure fasteners.

E. Brace Connectors

1. Provide lateral brace connectors to resist horizontal, lateral and vertical movement of suspended conduits during seismic earthquakes.
2. The braces shall connect from each conduit support, attach as close to the conduit as possible, and attach to fixed rigid, nonsuspended building “main” structural elements with fixed anchoring.
3. Brace attachment connectors and fasteners shall be rigid preformed steel channels or flexible #10 gauge steel hanger wire.
4. Connect and attach the brace connectors to fixed structural elements in the same manner as conduit support hangers. The connection of braces to structural elements shall be independent of the conduit support hanger structure fasteners.

2.04 ELECTRICAL POWER WIRE AND CABLE

A. General

1. All wire and cable shall be single-conductor, annealed copper, insulated 600 volt, #12AWG minimum unless specifically noted otherwise on the Drawings.

2. Conductors #10AWG and smaller shall be solid. Conductors #8AWG and larger shall be stranded.
 3. Insulation of conductor connected to circuit protection devices required to be "100%" rated, shall be 90 degree centigrade rated insulation.
 4. Insulation of conductors installed outdoors, on grade or underground, insulation shall be rated for wet locations.
 5. Insulation of conductors installed outdoors, installed exposed to the sun, installed in exposed conduits, insulation shall be rated for high-temperature 90 degrees centigrade.
 6. Insulation of branch circuit conducts installed in light fixtures, insulation shall be rated for 90 degrees centigrade.
 7. Conductor exposed to oil, insulation and jacket shall be oil resistant, complying with "Oil Resistant-1" and "Oil Resistant-2" UL 83.
- B. Conductor Insulation
1. 600 Volt AC and/or DC insulated conductors installed entirely inside conduits, or enclosed inside wireways, or enclosed inside raceways, insulation shall be rated as follows:
 - a. Indoor above Grade locations either concealed or exposed.
 - 1) Dual rated THHN and THWN
 - 2) Individually rated THHN-2
 - 3) Individually rated THWN-2
 - 4) XHHW-2
 - b. Outdoor above Grade either concealed or exposed.
 - 1) XHHW-2
 - 2) THWN-2
 - 3) THW-2
 - c. Outdoor below Grade or outdoor on Grade.
 - 1) XHHW-2
 - 2) THWN-2
 - 3) THW-2
 - d. All other enclosed raceway locations not described above.
 - 1) XHHW-2
 - 2) THWN-2
 - 3) THW-2
 2. Health Care facilities all circuits insulation shall be XHHW-2, rated Hospital-Grade.
 3. 600 Volt AC and/or DC insulated conductors installed in open cable tray or open wireway or exposed insulation also shall be rated for exposed install locations.
- C. Insulation Color Coding and Identification
1. The following color code for branch circuits:
 - a. Neutral . . . White (Tape feeder neutrals with white tape near connections)

- b. Normal Power

<u>120/208 Volt</u>	<u>480/277 Volt</u>
Ground Green	Ground Green
Phase A Black	Phase A Brown
Phase B Red	Phase B Orange
Phase C Blue	Phase C Yellow
 - c. Isolated ground insulation shall be green with a longitudinal yellow stripe.
 - d. Emergency power same insulation color as normal power except as follows:

<u>120/208 Volt</u>
Provide an additional continuous stripe on each conductor insulation, orange or yellow, except ground
<u>480/277 Volt</u>
Provide an additional continuous stripe on each conductor insulation blue or black, except ground
2. When individual neutral conductors are shown/required for each branch circuit, the color code for the neutral conductors shall be as follows:
 - a. 120/208 volt; Phase A - White with Black stripe; Phase B - White with Red stripe; Phase C - White with Blue stripe.
 - b. 277/480 volt; Phase A - White with Brown stripe; Phase B - White with Orange stripe; Phase C - White with Yellow stripe.
 3. Feeders identified as to phase or leg in each, switchboard, switchgear, panelboard and junction location with printed identifying tape.
 4. Fire alarm conductors: Use 600-volt, type THHN-2/THWN-2 conductors and color-coded per Equipment Manufacturer's recommendations and approved and listed for use on fire alarm systems by the State Fire Marshal.
 5. Color coding for mechanical and plumbing control wiring shall be an agreed upon color code between the Mechanical/Plumbing Contractor and the Electrical Contractor, and color code shall be submitted to the District's Representative in writing for approval prior to installation.

2.05 CHEMICAL GROUND ROD

A. General

1. Self-contained ground rod(s) using chemically enhanced grounding shall be provided where specifically indicated on the Drawings. As manufactured by Lyncole XIT Grounding Systems, 22412 South Normandie Avenue, Torrance, CA. Telephone #(800) 962-2610; or Superior Grounding Systems, Irwindale, CA. Telephone # (800) 747-7925; or ERICO – Eritech Chemical Ground Electrode.
2. The ground rod shall operate from changes in atmospheric pressure pumping air through the ground rod, hygroscopically extracting moisture from the air to activate the ground electrolytic chemicals and improve the ground rod performance.
3. Ground rod system shall be UL-467 listed.
4. Ground rod system shall be 100% self-activating, sealed and maintenance free. The addition of chemical or water solutions shall not be required.

B. Ground Rod

1. Ground rod shall consist of a 2-inches nominal diameter hollow, copper tube. The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of tube. Drainage holes shall be provided in the bottom and sides of the tube for electrolyte drainage into the surrounding soil.
2. The ground rod shall be chemically filled at the factory with environmentally non-hazardous water-soluble metallic salts to enhance electrical grounding performance.
3. Ground rod shall be a minimum of 10-feet long for straight (vertical) installation; or "L" shape minimum 20-feet long for horizontal installation.
4. Ground wire clamping "U-Bolt" with pressure plate on the top end of the tube sized for 1#2 through 500 MCM AWG ground electrode conductor connections, and stranded 4/0AWG copper pigtail exothermically welded to the side of rod for ground electrode conductor connection.

C. Ground Box

1. Precast concrete box with slots for conduit entrances. Approximately 10-inch diameter by 12-inches high. Cast iron grate flush cover with "Breather" slots XIT Box #XB-12.

D. Backfill Material

1. Natural volcanic, non-corrosive Bentonite Clay backfill material.
2. Shall absorb water at a minimum of thirteen times its dry volume or approximately 14 gallons for 50 pounds of clay.
3. PH Value 8-10 with maximum resistivity of 2.5 OHMS-M at 300% moisture content by weight.

2.06 FLEXIBLE CORDS AND PORTABLE CABLES

A. General

1. Multi-conductor insulated flexible cable with jacket rated extra heavy duty, extra hard-use and high abuse duty; ozone, sunlight, grease, oil resistant-UL 83 and water resistant; rated for indoor/outdoor use.
2. Quantity of conductors and conductor sizes as indicated on the Drawings but in no case less than five 16AWG.
3. Characteristics:
 - a. Conductors - stranded copper, soft annealed conforming to ASTM-B-174 and ASTM-B-172. 600 volt individually insulated and color-coded. Separate green insulated ground conductor. Aluminum conductors shall not be permitted for cords and cables.
 - b. Insulation - rubber conforming to UL 62; temperature range plus 105° Centigrade to minus 50° Centigrade.
 - c. Flame resistance shall conform with MSHA-P123-103.
 - d. Jacket - black for equipment connections and yellow for outlet connections. Rated for temperature range plus 105° Centigrade to minus 50° Centigrade, water, sunlight and ozone resistant. Permanently mark jacket a minimum of 40-inches on center with rated voltage, Manufacturer's name, wire/insulation type, AWG conductor size and quantity (minimum 24-inches on center).

2.07 CABLE RACKS

- A. Cable racks, installed on the vertical walls of the structure, including hooks and porcelain insulator cable cradles, shall be sufficient to accommodate the cables and splices.
- B. Vertical racks shall be installed on all walls of the structure a minimum of 24-inches on center within 6-inches of floor and top of wall. A rack shall be installed within 18-inches of each corner of each wall. Additional racks spaced equally on each wall shall be installed; spacing between vertical wall racks shall not exceed 24-inches.

- 1. Wall racks shall be slotted to accept removable hooks and lock hooks into place.
- 2. Non-metallic, 50% (minimum) glass reinforced nylon or non-metallic material of the same characteristics.
- 3. The installed cable racks, cable support hooks with arms and wall anchor bolts shall support the following minimum loads for each hook/arm, with a 200% minimum safety factor. Based on multiple hook/arms located not less than 9-inches on center along the entire vertical length of the support rack:

	<u>Hook/Arm Length</u>	<u>Min. Weight Each Hook/Arm Supported</u>	<u>Max. Allowable Hook/Arm Deflection</u>
a.	8-inches	450 pounds	0.25-inch
b.	14-inches	350 pounds	0.37-inch
c.	20-inches	250 pounds	0.37-inch

(Based on load concentrated 1-inch from the end of each hook/arm.)

- 4. Racks shall be bolted to the precast and cast-in place structure walls, within 3-inches of each rack end and not less than 9-inches on center. Provide cast-in place or after-set drilled expansion concrete anchors.

PART 3 - EXECUTION

3.01 TRENCHING, FOOTINGS, SLEEVES

- A. Provide trenching, concrete encasement of conduits, backfilling, and compaction for the underground electrical work, in accordance with applicable Sections of this Specification.
- B. Provide footings for all post and/or pole-mounted lighting fixtures: concrete shall conform to the applicable Sections of this Specification.
- C. Sleeves
 - 1. Provide sleeves for raceways, conduit and wire/cables passing through the following construction elements:
 - a. Concrete and masonry foundations, floors, walls and slabs.
 - b. Gypsum, Lath, and plaster walls and ceilings.
 - c. Building structures (i.e., foundations, walls, floors, ceilings, beams, and roofs) with a fire rating exceeding 20-minutes.
 - 2. Sleeves shall extend 1.5-inch above and below floors, except under floor standing electrical equipment. Sleeves shall be flush with wall ceiling foundations and partitions exposed to public view and extend approximately 0.5-inch past penetration in fire rated construction. Sleeves shall be installed at exact penetration locations and angles to accommodate wire/cable, raceway and conduit routings.

3. Joists, girders, beams, columns or reinforcing steel shall not be cut or weakened. Where construction necessitates the routing of conduit or raceways through structural members, framing or footings, written permission to make such installation shall first be obtained from the District's Representative. Such permission will not be granted, however, if any other method of installation is possible.
4. The layout and design of raceways and conduits located in or routed through masonry or reinforced beams or the District's Representative shall review walls before any work is performed. All sleeving shall be accomplished according to the instructions of the District's Representative and shall be accepted before any concrete is poured.
5. Sleeves, raceways and conduit shall be located to clear steel reinforcing bars in beams. Reinforcing bars in walls shall be offset to clear piping and sleeves.
6. Provide a continuous clearance between the inside of a sleeve and exterior of wire/cables, conduits and raceways passing through the sleeve not less than the following:
 - a. 0.5-inch clearance except as required otherwise.
 - b. 1.0-inch clearance through outside walls below grade.
 - c. 3.0-inch clearance through seismic joints.
7. Sleeves set in fire rated construction shall be caulked between sleeve and building structure, additionally sleeves shall be caulked between the sleeve and the wire/cables, conduits/raceways passing through the sleeve. The caulking shall be a fireproof sealant, equal to the fire rating and temperature being penetrated. Clearance between components inside of sleeve and exterior of components passing through sleeve and between components inside the sleeve shall comply with Fire-Proof Sealant Manufacturer's recommendations.
8. Sleeve material:
 - a. In floor construction: Schedule 40 black steel pipe, with upper surface to be sealed watertight.
 - b. In concrete or masonry walls roofs or ceilings: Schedule 40 black steel pipe. When installed in roofs or outside walls, seal outer surface watertight.
 - c. In fire rated construction; 24 gauge galvanized iron or steel.
 - d. Sleeves through waterproof membranes: Cast iron or Schedule 40 steel with flashing clamp device and corrosion resistant clamping bolts. Caulk space between pipe and sleeve and sur-faces between sleeve and conduits sealed watertight.

3.02 GROUNDING

- A. Grounding shall be executed in accordance with all Applicable Codes and Regulations, both of the State and Local Authorities Having Jurisdiction.
- B. Where nonmetallic conduit is used in the distribution system, the Contractor shall install the proper sized copper ground wire in the conduit with the feeder for use as an equipment ground. The electrical metallic raceway system shall be grounded to this ground wire.
- C. The maximum ground/bond resistance to the grounding electrode shall not exceed 1 ohms from any location in the electrical system. The maximum ground resistance of the grounding electrode to earth shall not exceed 5 ohms.

D. Ground/Bond Conductors

1. Provide an additional, dedicated, green insulation equipment ground/bond wire inside each conduit type and raceway as follows. Size the ground/bond conductors to comply with CEC/NEC Requirements. The metal conduit or raceway shall not be permitted to serve (function) as the only (exclusive) electrical ground return path:
 - a. All types of nonmetallic conduit and all types of non-metallic raceways including but not limited to: RNMC – Rigid Nonmetallic Conduit.
 - b. FMC - Flexible Metal Conduit.
 - c. LTFMC - Liquid Tight Flexible Metal Conduit.
 - d. Metal and non-metal raceways.
 - e. RMC - Rigid Metal Conduit.
 - f. EMT - Electrical Metal Tubing.

2. The equipment ground/bond wire shall be continuous from the electrical circuit source point of origin to the electrical circuit end termination utilization point as follows:
 - a. Every conduit and raceway path containing any length of the above identified conduits or race-way.
 - b. Every conduit path and raceway path connected to any length of the above-identified conduits and raceways.

3. The equipment ground/bond wire shall be sized as follows, but in no case smaller than indicated on the Drawings. Install equipment ground/bond wire in each conduit/race-way, with the respective phase conductors:

<u>Feeder, Subfeeders & Branch Circuit Protection</u>	<u>Min. Equip. Grnd Wire Size</u>
15 amp	#12
20 amp	#12
30 to 60 amp	#10
70 to 100 amp	#8
101 to 200 amp	#6
201 to 400 amp	#2
401 to 600 amp	#1
801 to 1000 amp	2/0
1001 to 1200 amp	3/0
1201 to 1600 amp	4/0
1601 to 2000 amp	250 MCM
2001 to 2500 amp	350 MCM
2501 to 4000 amp	500 MCM

4. Isolated grounds - Raceways containing branch circuit or feeder phase conductors connected to panelboards equipment, or receptacles with isolated grounds or isolated ground bus shall contain a dedicated insulated ground conductor connected to the isolated ground system only. The isolated ground conductor shall be continuous the length of the raceways and connected only to the isolated ground terminals in addition to and independent of the equipment bonding/ground conductor. The isolated ground conductor shall be sized as indicated above, for equipment ground/bond wire.

5. Splices in ground/bond wires shall be permitted only at the following locations:
 - a. Ground buses with listed and approved ground lugs.

- b. Where exothermic welded ground/bond wire splices are provided.
- 6. Provide ground/bond wire jumpers for conduit fittings with ground lugs, expansion and deflection conduit fittings at conduit fittings connecting between metallic and non-metallic raceways and to bond metal enclosures to conduit fittings with ground lugs.
- E. Where conductors are run in parallel in multiple raceways, the grounding conductor shall be run in parallel. Each parallel equipment-grounding conductor shall be sized on the basis of the ampere rating of the over-current device protecting the circuit conductors in the raceway. When conductors are adjusted in size to compensate for voltage drop, grounding conductors, where required, shall be adjusted proportionately in size.
- F. Ground conductors for branch circuit wiring shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws, 6-32 or larger.
- G. Each panelboard, switchboard, pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.
- H. UFER Ground
 - 1. In addition to all cold water and structural steel grounds provided to meet this Specification, there shall be a main ground system of the UFER ground style.
 - 2. The UFER ground electrodes shall be a minimum of two 20-foot lengths of #4/0 AWG bare stranded copper cable embedded horizontally in the cast in place concrete footing, extending in opposite directions in the footings. All portions of the ground electrodes shall be placed inside the concrete, between 2-inches and 4-inches from the earth surrounding the concrete.
 - 3. The lengths of cable shall extend in opposite directions in the footings, with the center end of each cable terminated onto the main electrical service ground bus for the main electrical service equipment.
 - 4. All wire cable connection terminations onto the ground bus shall be exothermic weld type.
 - 5. The "UFER" grounding electrode, embedded in concrete, shall be exothermically welded to each steel reinforcing bar (rebar) and each steel anchor bolt located within 18-inches of the grounding electrode inside the concrete. Note: Reinforcing steel (rebar), in concrete foundations, attached with metal "tie-wraps" and in direct physical contact to other adjacent rebar that is in turn exothermic welded to the UFER grounding electrode, may be classified as attached to the UFER grounding electrode, and does not require additional exothermic weld connections to the UFER grounding electrode.
- I. Provide a separate ground/bond insulated grounding electrode conductor, copper wire from the main electrical service ground bus to each of the following locations. The ground/bond conductor shall be sized to comply with applicable Codes and as indicated on the Drawings, but in no case smaller than the following:
 - 1. Main service entrance equipment ground bus:
 - a. Services smaller than 1200 amp 1.5-inch conduit with 1#4/0.
 - b. Services 1200 amp and larger 2.5-inches conduit with 1#500MCM.

- c. Where a separate ground bus is not required, connect ground to electrical equipment metal housing
- 2. Each telephone backboard and signal system backboard location, 1.25-inch conduit with 1#1.
- 3. Metal cold water pipe located inside the building, 1.5-inch conduit with 1#4/0.
- 4. Outdoor underground metal cold water pipe, make connection 5-feet from the building, 1.5-inch conduit with 1#4/0.
- 5. Each service entrance ground bus and each separately derived ground rod system:
 - a. Services smaller than 1200 amp 1.5-inch conduit with 1#4/0.
 - b. Services 1200 amp and larger 2.5-inches conduit with 1#500MCM.
- 6. Separate 1.25 inch conduit with 1#2 (AWG) bonding conductor to each interior metal pipe system located in the same building, including but not limited to, the following:
 - a. Fire sprinkler system each stand-pipe location (water based and non-water based).
 - b. HVAC chilled water supply and return, at each pump location.
 - c. Roof drains.
 - d. Waste liquid disposal systems.
 - e. Metal gas pipe service entrance and service meters.
 - f. Hydraulic elevator hydraulic pipes.

3.03 CONDUIT

A. General

- 1. The sizes of the conduits for the various circuits shall be as indicated on the Drawings, but not less than the conduit size required by Code for the size and quantity of conductors to be installed in the conduit.
- 2. Conduits shall be installed concealed from view. Install conduits concealed in walls, concealed below floors and concealed above ceilings, except as specifically noted otherwise.
 - a. Conduits shall not be installed in concrete floors.
- 3. The following systems shall be considered as circuits 100 volts and less, all other circuits shall be considered to be over 100-volts (power circuits) unless specifically noted otherwise: Fire alarm, energy management control, telephone, public address, data, computer, television, intercom, intrusion alarm and nurse call.
- 4. Conduits shall be provided complete with conduit bends, conduit fittings, outlet boxes, pullboxes, junction boxes, conduit anchors/supports, and grounding/bonding for a complete and operating conductor/ wire raceway system.
- 5. Metal and nonmetal conduits shall be provided mechanically continuous between termination connection points. Metal conduit shall be provided electrically continuous between termination connection points.
- 6. Individual conduit paths and home runs shown on the Drawings shall be maintained as separate individual conduits for each homerun and path.

7. Conduits, conduit fittings and installation work occurring in classified hazardous materials locations shall comply with applicable Code Class 1 Division 1 Requirements, unless specifically noted otherwise.
8. Transitions between conduits constructed of different materials and occurring in above grade locations shall be allowed only at outlet boxes, junction boxes, pullboxes and equipment enclosures unless specifically indicated otherwise. Provide outlet boxes and junction boxes.
9. Metal conduit terminating to nonmetal enclosures; terminating into metal enclosures with “concentric ring” knockouts; terminating into metal enclosures with knockout reducing washers, including but not limited to equipment housings, outlet boxes, junction boxes, pull boxes, cable trenches, manholes, shall be provided with a ground/bonding lug integrated with the conduit termination conductor fitting construction, by the Fitting Manufacturer. The lug shall provide for connection of a grounding/bonding conductor (insulated or uninsulated). The grounding lug shall be located on the fitting, inside the termination enclosure.
10. The type of conduit, type of conduit fittings, and type of conduit supports and method of conduit installation shall be suitable for the conditions of use and conditions of location of installation based on the Manufacturer’s recommendations; based on the applicable Codes and based on the Requirements of the Contract Documents.

B. RMC Installation Locations

RGS, IMC conduits and RGS, IMC fittings shall be installed in the following locations:

1. Embedded in floors, walls, ceilings, roofs, foundations, and footings constructed with concrete.
2. Embedded in walls and foundations constructed with brick and masonry.
3. Interior of buildings, within 9-feet of finish floor lines for exposed conduit locations.
4. Exterior of building for exposed conduit locations.
5. Damp or wet locations, exposed or concealed locations.
6. Exposed on roofs.
7. In hazardous materials areas and locations; below hazardous materials areas and locations; above hazardous materials areas and locations.
8. Exposed on utility service poles, for pole risers less than 9-feet above finish grade.
9. RMC conduit and RMC fittings may be installed in any location where EMT and FMC conduit is permitted to be installed.

C. PVC Coated RMC Installation Locations

PVC coated RMC conduit and PVC coated RMC fittings shall be installed in the following locations:

1. Underground conduit locations for elbows and bends with a radius of less than 36-times the conduit diameter.
2. Underground vertical risers extending above grade.
3. Entire length of underground conduits for the following circuits:
 - a. Audio microphones

- b. Lighting dimming controls
 - 4. Installed in contact with earth or corrosive materials.
 - 5. Exposed in “cold” rooms and “refrigerated” rooms, rooms with a maintained temperature below 65 degrees Fahrenheit.
- D. EMT Installation Locations
- EMT conduit and EMT fittings may be installed in the following locations, for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry locations:
- 1. Concealed in hollow non masonry/non-concrete, metal stud frame and wood stud frame walls and floors.
 - 2. Concealed above ceilings.
 - 3. Exposed inside interior enclosed crawl spaces.
 - 4. Exposed interior locations placed 9-feet or higher above finished floors (except as described in paragraph below at lower heights).
 - 5. Exposed on walls and ceilings (any height) in the following dedicated function areas, interior enclosed room locations:
 - a. Indoor enclosed electrical equipment rooms and closets.
 - b. Indoor enclosed data and telecommunication terminal rooms and closets.
 - c. Indoor enclosed HVAC equipment rooms and closets.
 - 6. Any location where FMC is described to be installed, except as the final connection to rotating or vibrating equipment.
- E. FMC Installation Locations
- FMC conduit and FMC fittings may be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry, interior locations:
- 1. Concealed in hollow non-masonry metal stud frame and wood stud frame fully enclosed walls.
 - 2. Concealed above fully enclosed ceiling spaces.
 - 3. FMC conduit shall be installed in continuous lengths between termination points. FMC shall not be “spliced” or coupled directly to FMC or any other conduit type under any circumstance.
 - 4. The maximum continuous length of FMC that shall be installed between termination end points is 15-feet. Circuits requiring continuous conduit lengths exceeding 15 feet between termination end points shall be installed using either RMC or EMT conduits. FMC lengths shorter than 16-inches are prohibited.
 - 5. The minimum size FMC conduit shall be as shown on the Drawings but not be less than the following:
 - a. FMC lengths of 6-feet or less, minimum FMC conduit size shall be 0.50-inch.
 - b. FMC lengths exceeding 6-feet, minimum FMC conduit size shall be 1.0-inch.

F. LTFMC Installation Locations

LTFMC conduit and LTFMC fittings shall be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”:

1. Final electrical connection to vibrating or rotating equipment; control and monitoring devices mounted on vibrating and rotating equipment including the following. Minimum conduit length shall not be less than 24-inches:
 - a. Motor, engines, boilers, solenoids, and valves.
 - b. Fixed mounted “shop” (manufacturing) production equipment.
 - c. Fixed mounted food preparation equipment and “kitchen” equipment.
2. All locations where exposed flexible conduit connections are required, both indoor and outdoor.
3. Final connection to indoors electrical transformers. Minimum conduit length shall not be less than 24-inches; maximum conduit length shall not exceed 72-inches.
4. Do not install LTFMC located in environmental air plenums.

G. RNMC Installation Locations

RNMC conduit and RNMC fittings shall be installed in the following locations containing only “non-hazardous material”:

1. Underground, concealed below earth grade, unless specifically noted or specified otherwise.
2. Exposed on utility service poles, for pole risers at 9-feet or higher above finish grade, Schedule 80 PVC only.
3. RNMC type “EB” conduit(s) shall be concrete encased along the entire length of the conduits for all installation locations.
4. Non-metal type raceways and RNMC type conduit shall not be installed inside buildings.

H. Combi-Duct Installation Locations

Combi-duct conduits shall be installed where shown on the Drawings. Combi-duct shall be installed under-ground (below grade) as follows:

1. Do not install exposed or inside buildings above grade.
2. Provide a 0.25-inch pull rope in each inner duct.
3. Radius and elbows shall be rigid non-metallic, PVC, Manufacturer factory fabricated, in lieu of PVC coated RMC conduit.
4. Inner ducts shall be supported by internal spacers inside the enclosing outer duct.
5. Provide end bell and three-hole “snug-plugs” at each entrance end of Combi-duct into pullboxes, man-holes, equipment cabinets’ stub-ups and Combi-duct terminations. Compression type “snug-plugs” shall provide watertight and airtight seal between inner and outer ducts and around future cables installed in inner duct.

I. Conduit Installation

1. Conduit Supports

- a. Securely and rigidly support all raceways/conduits from the building structure. Raceways/Conduits shall be supported independent of all piping, air ducts, equipment ceiling hanger wires, and suspended ceiling grid systems. Secure conduit to structural element by means of UL listed and approved hangers, fasteners, "C" channels and pipe clamps.
- b. Provide conduit supports spaced along the length of the conduit as follows:
 - 1) RMC and EMT conduit, maximum not to exceed 96-inches on center; within 24-inches of each conduit bend and conduit termination location.
 - 2) FMC and LTFMC conduit, maximum not to exceed 24-inches on center; within 6-inches of each conduit bend and conduit termination location.
- c. Suspended conduit methods:
 - 1) Individual, suspended raceways/conduits separated by more than 12-inches from any other conduit and suspended from ceilings and roofs shall be supported as follows:
 - a) Conduits smaller than 1.5-inches by means of hanger rods or hanger wires.
 - b) Conduits 1.5-inches and larger by means of hanger rods.
 - c) The conduit shall attach to the hangers with pipe clamps.
 - 2) Suspended raceways/conduits positioned within 24 inches of any other conduit shall be grouped and supported by hanger rods using trapeze type conduit support channels ("C" channels). Conduits shall individually attach to common channels side-by-side, with pipe clamps.
- d. Non-suspended conduit methods:
 - 1) Individual raceway/conduits placed against wall/ceiling/floors, placed inside hollow wall/ceiling construction or structure framing (i.e., "drywall" or plaster hollow wall construction), shall be secured by means of individual pipe clamps and fasteners attached to the framing studs or other structural members and the conduit/raceway.
 - 2) Provide common "C" channel supports for all multiple raceway/conduits placed against vertical or horizontal surfaces and positioned within 24-inches of other raceways/conduits. Attach channels to the framing studs or other structural members. Attach the conduits/raceway individually to common channels, side-by-side, with pipe clamps.
 - 3) The use of toggle bolts is prohibited.
- e. Conduit rising from floor for motor connection shall be independently supported if extending over 18-inch above floor. Support shall not be to a motor or ductwork, which may transmit vibrations.
- f. Provide conduit anchoring, conduit support and conduit bracing systems conforming to Earthquake Requirements. The conduit support/anchoring system capacity shall include the weight of the conduits, conduit fittings, conduit supports and conductors /wires/cables installed in the conduits plus a 300% safety factor. Submit Shop Drawing details showing each typical conduit anchor, conduit support and conduit brace location. Submit structural calculations performed by and signed by a Professional Structural Engineer (P.E.) with a P.E. License, Registered in the State of California, U.S.A.

2. Conduit separation:
 - a. Conduit installed underground or below building slab without full concrete encasement: Shall be separated from adjacent conduits of identical systems (i.e. signal to signal, data to data, power to power, control to control etc.) by a minimum of 3-inches. Conduits of non-identical systems (i.e. signal to power; data to power; power to control; signal to control, etc.) shall be separated by a minimum of 12-inches.
 - b. Conduit installed underground with full concrete encasement; shall be separated from adjacent conduits of similar systems (100 volt and less) by a minimum of 2-inches; conduits for non-power systems (100 volts and less to ground) shall be separated by a minimum of 6-inches from power circuits (over 100 volts to ground); conduits for power circuits shall be separated from adjacent conduits of similar power systems (over 100 volts to ground) by a minimum of 3-inches.
 - c. Separation of conduits entering termination points or crossing other conduits may be reduced as required within 60-inches of the termination or crossing points.
 - d. Conduits containing Utility Company service circuits (i.e. electrical power, telephone, or cable television) shall be separated a minimum of 12-inches from all other utilities and conduits, with or without concrete encasement; metallic or non-metallic conduit, above grade or underground conduit locations.
 - e. Conduits shall be separated from hot water piping, exhaust flues/chimneys, steam piping, boilers, furnaces, ovens by a minimum of 12-inches.
3. Conduit stubs:
 - a. Branch circuit and telephone conduits turned up from floor at the following locations shall terminate each conduit in a flush conduit coupling at the floor and then extend into partition or to equipment. Refer to District's Representative's Drawings for location of walls and partitions.
 - 1) Interior demountable partitions.
 - 2) Below, into or adjacent to equipment not installed directly adjoining to a wall.
 - 3) Up from below the floor into hollow stud frame walls.
 - b. From each panel, and signal cabinet which is wall mounted, stub up from top of the panel/cabinet a minimum of three 1-inch conduits to the nearest accessible ceiling spaces or other accessible location. Where the floor below the panel is accessible or is a ceiling space, stub an additional three 1-inch conduits from the bottom of the panel into the accessible space below the panel. Cap conduits for future use.
 - c. Conduits stubbed underground outside of building line for future use shall be terminated a minimum of 5-feet clear (whichever distance is greater) of building or adjacent concrete walks and AC paving. The stubout conduit shall be capped. Provide concrete monuments, 6-inches by 6-inches by 15-inches deep, buried flush with grade over the capped ends. The face of monument shall be furnished with 3-inch square brass plates securely mounted and engraved with the number and size of conduits and type of service (i.e., "POWER", "TEL.", etc.).
 - d. Conduits stubbed into ceiling or floor spaces from outlets for telephone, video, computer/data or television shall be provided with an insulated throat bushing, on the end of each conduit stubout.

- e. Conduit stubouts from outlet boxes and equipment located in hollow stud walls, into ceiling and floor spaces, shall be EMT or RMC conduit. The stubouts shall terminate into the ceiling and floor spaces with a conduit termination connector fitting.
 - f. Empty conduit stubs into building spaces and equipment shall be individually identified with an "ID-tag" located at each end of the conduit. The ID-tag shall state the origination point and termination point of the respective conduit (i.e., "from PNL-A/to Room #121"; "from outlet #24/to outlet #17 in Room #120"; etc.).
 - g. Provide a conduit termination fitting with insulated throat bushing and mechanical ground lugs at each conduit "stub-up" location.
4. Conduit concrete encasement:
- a. Conduits which are run underground exterior to building slab shall be continuously concrete encased except, 15-amp and 20-amp power branch circuit conduits underground do not require concrete encasement.
 - b. PVC rigid-non-metallic-type EB conduit, of any size and any location shall be continuously concrete encased the full length of the conduit installation, including under building slab.
 - c. Concrete for encasement of underground conduits shall be 2000-PSI 28-days cure strength with a mix of cement, sand, water and maximum of ¾-inch gravel. Concrete encasement of conduits shall be continuous without voids. The encasement shall extend 3-inches past the edges of all conduits on all sides of the circuit. Provide 10-pounds of red oxide cement coloring uniformly mixed with each cubic yard of concrete for conduit encasement.
 - d. Conduits located below or adjacent to structural foundations shall be separated from the foundation by a minimum of 12-inches. Conduits located below structural foundations shall be fully and continuously concrete backfilled and encased between the bottom of the foundation to the bottom of the conduits. The concrete shall be 4000 PSI 28 day cures strength instead of 2000-PSI concrete.
 - e. Conduits of any size and type (including 15-amp and 20-amp power branch circuits) located under roads, paved areas and "transit-system" right of way shall be concrete encased.
5. Underground conduits:
- a. Three or more underground conduits larger than 1-inch in size and occupying the same trench shall be separated and supported on factory fabricated, non-metallic, duct/conduit support spacers. The spacers shall be modular, keyed interlocking type, "built-up" to accommodate quantity, size orientation and spacing of installed conduits.
The spacers shall maintain a constant distance between adjacent conduit supports and hold conduits in place during trench backfill operations. Minimum support spacer installation interval along with length of the conduits shall be as follows:
 - 1) Concrete encased conduits, not less than 8-feet on center.
 - 2) Non-concrete encased conduits, not less than 5-feet on center.
 - b. Provide trenching, excavation, shoring and Backfilling required for the proper installation of underground conduits. Tops of backfill shall match finish grade.
 - c. Bottoms of trenches shall be cut parallel to "finish grade" elevation. Make trenches 12-inches wider than the greatest diameter of the conduit.

- d. Backfilling Trenches for Conduits without Concrete Encasement Requirements
 - 1) Conduits which are not required by the Contract Documents to be concrete encased and are located exterior to building slab, shall be set on a 3-inch bed of damp clean sand. Conduit trenches shall be backfilled to within 12-inches of finished grade with damp sand after installation of conduit is completed. Remainder of backfill shall be native soil.
 - 2) Conduits located under a building which are not required by the Contract Documents to be concrete encased, shall be completely backfilled and compacted with clean damp sand to the same level as the building foundation pad.
 - 3) Provide a continuous yellow 12-inches wide flat plastic tracer tape, located 12-inches above the conduits in the trench. The tracer tape shall be imprinted with "Warning-Electric Circuits" a minimum of 24-inches on center.
- e. Backfilling trenches for conduits under paved areas:
 - 1) In addition to the Requirements of conduit concrete encasement, conduits under walkways, roads, parking lots, driveways, and buildings shall be cast in place concrete "slurry mix" backfill. The slurry mix shall cover each side and top of conduits and conduit concrete encasement. The slurry mix shall be continuous to the underside of the finish subgrade surface.
- f. Backfilling trenches for conduits with Concrete Encasement Requirements by the Contract Documents:
 - 1) Trenches with all conduits concrete encased shall be backfilled with clean damp sand when located under building pads.
 - 2) Trenches with all conduits concrete encased and not located under a building pad and not located under paved areas shall be backfilled with clean damp sand or native soil.
- g. Backfill material:
 - 1) Sand and native soil backfill of trenches shall be machine vibrated in 6-inch lifts to provide not less than 90% compaction of backfill.
 - 2) Soil backfill shall have no stones, organic matter of aggregate greater than 3-inches.
 - 3) Concrete and slurry mix (2000-PSI) shall be machine vibrated during installation to remove "air-voids".
 - 4) The slurry mix shall consist of concrete, clean rock, clean sand and clean water mixture. Maximum shrinking of slurry mix shall not exceed 5% wet to dry.
- h. Do not backfill until District's Representative has approved Installation and As-Built Drawings are up to date. Promptly install conduits after excavation has been done, so as to keep the excavations open as short a time as possible. Excess soil from trenching shall be removed from the site.
- i. Install underground conduit, except under buildings, not less than 24-inches below finished grade in non-traffic areas and 30-inches below finished grade in traffic areas, including roads and parking areas. Not less than 48-inches below finished grade under public/private transit system right of way and railroad right of way. Dimensions shall be measured to the top of the conduit.

- j. Conduit crossing existing underground utilities shall cross below the bottom depth of the existing utilities. If the top portion of the existing utility depth below finish grade exceeds 72-inches and the specified separation and depths are maintained when crossing over the top of the existing underground utility, the conduit may cross above the existing underground utility.
 - k. Provide long radius horizontal bends (minimum radius of 36-times the conduit diameter) in underground conduits where the conduit is in excess of 100-feet long.
 - l. Conduits installed below grade and on grade below buildings, shall not be smaller than 0.75-inches. Conduits for circuits exceeding 600-volts shall not be smaller than 5.0-inches.
 - m. Underground conduits entering a building shall be sloped. The conduit direction of slope shall be away from the building, and shall prevent water in the conduit from “gravity draining” towards the building. The conduit slope “high point” shall originate from the building, out to the first exterior pullbox, manhole etc. exterior conduit termination “low point”. The minimum slope angle shall be a constant 8-inches (or greater) of fall for each 100-feet of conduit length.
 - n. Dewatering:
 - 1) Provide pumping to remove, maintain and dispose of all water entering the excavation during the time the excavation is being prepared, for the conduit laying, during the laying of the conduit, and until the backfill at the conduit zone has been completed. These provisions shall apply on a continuous basis. Water shall be disposed of in a manner to prevent damage to adjacent property. Trench water shall not be drained through the construction. Ground water shall not be allowed to rise around the pipe until joining compound has firmly set.
 - 2) The District’s Representative shall be notified 48 hours prior to commencement of dewatering.
6. Raceway/Conduits, which are installed at this time and left empty for future use, shall have 0.25-inch diameter polyvinyl rope left in place for future use. The pull rope shall be 500-pound minimum tensile strength. Provide a minimum of 5-feet of slack at each end of pull ropes.
7. Unless otherwise restricted by Structural Drawings and Specifications, the maximum size conduit permitted in concrete slab on-grade, walls, ceilings and roofs constructed of masonry or concrete shall not be greater than 20% of the concrete/masonry thickness. Conduits installed in these locations shall not cross.
- a. Conduits shall not be installed in cast-in-place concrete floors.
8. Provide openings in building structures for conduit penetrations:
- a. New construction shall be provided with conduit sleeves, to provide conduit penetrations.
 - b. Existing construction shall be drilled (core drill masonry and concrete) and provide conduit sleeves installed after drilling, to provide conduit penetrations.
 - c. Where the structure penetrations for underground conduits penetrating through foundations will not comply with the (restriction/penetration) shown in the Contract Documents, install the conduits below and clear of the foundation lowest point.

9. Conduit bends risers and offsets:
- a. The minimum bend radius of "factory or field" fabricated conduit bends shall not be less than the following. The bend radius shall be measured at the surface, inside radius of the conduit wall:
 - 1) FMC and LTFMC conduit - conduit minimum bend radius 12-times the conduit diameter.
 - 2) RMC and EMT conduit minimum bend radius – conduit for power circuits over 100 volts and less than 600 volts, 8-times conduit diameter. Conduit for power circuits over 600 volt, 12-times conduit diameter. Conduit for low voltage, signal and fiber optic circuits, 10-times conduit diameter.
 - 3) RNMC conduit - conduit minimum bend radius 36-times the conduit diameter. Under building reduce minimum bend radius to 10-times the conduit diameter. Conduit bends and offsets in RNMC with less than 36-times conduit diameter bend/offset radius shall be RNMC PVC Schedule 80 or PVC coated RGS.
 - 4) Conduits for Utility Company conductors. Conduit minimum bend radius shall comply with the respective Utility Company Requirements.
 - b. Bends and offsets in conduits shall be kept to an absolute minimum. The total summation of all bends and offsets permitted in a conduit segment, occurring between two conduit termination/connection end points, shall not exceed the following, including conduit fittings:
 - 1) RMC and EMT conduit – 360 angular degrees
 - 2) FMC and LTFMC conduit – 180 angular degrees
 - 3) RNMC conduit – 270 angular degrees
 - c. Each field fabricated conduit offset, bend and elbow which are not the standard product of the Raceway/Conduit Manufacturer shall be mandrel tested. The test shall be conducted after the conduit installation is complete and prior to pulling-in any wire, in the same manner as for underground conduits.
 - d. Factory manufactured angle connector conduit fittings shall be installed in exposed conduit locations only. Installation in locations normally concealed from view shall not be permitted. Not more than one factory manufactured angle connector shall be permitted in any length of conduit between conduit termination end points.
 - e. RNMC conduit risers from below grade shall be PVC coated RGS. Conduit risers, bends or offsets entering into a building shall be PVC coated RGS.
 - f. If three or more conduit-bends of the same conduit size and same conduit material type, installed, as part of the Contract Work, fail to comply with the required minimum conduit bend radius or conduit angular degree limits. The following corrective actions shall occur:
 - 1) The Contractor shall remove all the non-complying conduit bends and the respective wire in the conduit from the project site. Provide new conduit and wire, complying with the Contract Documents.
 - 2) Where the conduit bends similar to the non-complying conduit bends are installed concealed in walls, floors, above ceilings or below grade, the Contractor shall expose the conduit bends to allow visual observation.
 - 3) The Contractor shall remove the non-complying conduit bends and dispose of the Project Site. The Contractor shall provide new conduit bends and conductors complying with the Contract Documents.

- 4) All the costs to correct the deficient material and work along with costs to repair the direct, indirect, incidental damages and Contract delays shall be the sole responsibility of the Contractor and shall be included in the bid price.
10. Expansion joint, deflection joint and seismic joint fittings.
- a. Provide a conduit expansion fitting for each conduit length and conduit type as follows (Note - The installation of specified combination expansion/deflection fittings at seismic joints shall satisfy this Spacing Requirement also):

<u>Conduit Type</u>	<u>Conduit</u>	<u>Fitting Length Spacing</u>
1) RMC and EMT	Exposed exterior locations	200-foot
2) RMC and EMT	Interior weather protected locations	200 feet
 - b. Provide a conduit combination expansion/deflection fitting for each conduit, crossing the following elements:
 - 1) At each building or non-building structure seismic joint.
 - 2) At each building on non-building structure expansion joint.
 - 3) At each conduit penetration of a "sound-rated" wall, floor or ceiling.
11. Provide two locknuts and an insulated throat bushing at each metal conduit terminating at enclosures, including but not limited to outlet boxes, junction boxes, terminal cabinets, switchgear, transformers, switchboards, distribution panels and panelboards.
12. Provide metallic or plastic closure caps on all conduit ends during construction, until installation of conductors in the respective conduit.
13. Conduit run exposed, shall be run at right angles or parallel to the walls or structures. All changes in directions, either horizontally or vertically, shall be made with conduit outlet bodies as manufactured by Crouse Hinds, OZ or equal. Conduits run on exposed beams or trelliswork shall be painted to match surrounding surfaces.
14. Conduit exposed on roof:
- a. Conduits installed exposed on roofs shall be installed on conduit sleepers. Place the conduit sleepers a maximum 5-foot on center along the entire length of the conduit; under conduit expansion/deflection fittings; under each junction box and within 24-inches of each conduit bend.
 - b. Provide a conduit support "C" channel continuous along the top length of the sleeper and rigidly bolted to the sleeper. Conduits shall be loosely fastened to each sleeper "C" channel with pipe clamps to allow for relative movement between the sleeper and conduit.
 - c. Conduits shall not block or interfere with roof hatches, doors, ventilation openings, dampers, equipment access panels/doors, roof water drainage.
 - d. Conduit sleepers shall be fabricated from "clear" solid redwood 4-inches by 4-inches (nominal) size. Sleeper length shall extend a minimum of 9-inches past the conduits attached to the sleeper, but in no case shall the length of the sleeper be less than 24-inches.
 - e. Provide a pad under each sleeper; sleepers shall not be installed in direct contact with the roofing. Sleeper pads shall extend a minimum of 6-inches past each side of the sleeper. The sleeper pad shall be semi-rigid mineral surfaced composition board, not less than 0.375-inch thickness, bituminous impregnated, manufactured for application on the specific roofing material. Remove roofing "ballast" (gravel) under pad, prior to installation of sleeper pad. Do not puncture roof membrane.

- f. Position the “length” of the conduit sleepers’ perpendicular to the roof slope, to prevent obstruction of roof drainage water flow. Where the conduit routing prevents placing the conduit sleeper parallel to the roof slope, provide two separate sleeper pads for the conduit sleeper, with a continuous 3-inches wide water drainage gap between the sleepers. Align the water drainage gap to allow unimpeded water travel along the roof slope drainage flow line between the pads.
 - g. Sleepers and sleeper pads shall be set in nonhardening mastic, a minimum of 0.25-inch thickness. Mastic shall be inorganic, nonhardening, and complying with ASTM-D1227. Mastic shall be applied with continuous uniform coverage, minimum 0.25-inch thickness, on all the surfaces of each conduit sleeper and on the sleeper pad contact surface with the roof.
15. Rigid steel conduit or electrical metallic tubing shall not be strapped or fastened to equipment subject to vibration or mounted on shock absorbing bases.
16. RMC conduit threads:
- a. Machine cut threads on RMC conduit required for field fabrication shall comply with NPS and ANSI-B1.20.1.
 - b. The length of bare metal exposed during thread fabrication shall be completely covered by conduit couplings and fittings. Additionally, the thread length shall insure that conduit joints will reach “torque” tightness and become secure before conduit ends “butt” together and before conduit ends “butt” into the “shoulders” of other conduit fittings.
 - c. Running threads or right/left handed threads shall not be used to connect RMC.
17. RNMC conduit:
- a. Joints and fittings shall be solvent welded to RNMC conduit. Joints and fittings shall be watertight and airtight after fabrication.
18. Tighten each conduit fittings and fitting appurtenance, to the “torque” (allowable tolerance $\pm 5\%$) value recommended by the Fitting Manufacturer and applicable Code. If three or more conduit fittings are found to not be in compliance with the Manufacturer’s “torque” (tightness) recommendations, the following corrective actions shall occur:
- a. The Contractor shall tighten “re-torque” the defective fittings and all similar conduit fittings installed as part of the Contract Documents in the presence of the District’s Representative.
 - b. If the respective conduit fittings similar to the deficient “torque tightness” fittings are installed concealed in walls, floors, above ceilings or below grade, the Contractor shall expose the fitting, to allow retightening each similar conduit fitting to the Manufacturers recommended “torque” values.
 - c. All the cost to repair the direct, indirect, incidental damages and Contract delays resulting from complying with these Requirements shall be the sole responsibility of the Contractor and shall be included in the bid price.
19. Horizontal directional boring for underground conduit:
- a. Provide a directional guided horizontal “bore-hole” underground conduit installation where one or more of the following conduits occur:
 - 1) Continuous trenching excavation and backfill for conduit installation is not permitted by the Contract.

- 2) Where continuous trenching excavation due to the existing surface and below grade conditions and restrictions, is not possible or practical to excavate a trench.
 - b. Provide “path-tracing” of the underground bore head, from the surface, along the entire horizontal bore length. Path tracing shall use electronic transmitters and receivers, continuously communicating the underground bore head locations and depth to the bore equipment operator. The directional boring system shall employ active tracking and directional position/steering control of the bore equipment drill head location. The active tracking system shall provide a portable receiver/transmitter unit for tracking the position of the moving drill head; a sensor “Sonde” unit on the drill head for tracking signals to the receiver/transmitter; and a drill head tracking data view display located at the boring equipment operator position to view the drill head position information sent from the portable receiver/transmitter. As manufactured by SPX-Radiodetection Company or similar products.
 - c. Provide vertical pilot excavations not more than 50-feet on center along the path of the bore-hole to intercept the horizontal bore-hole routing, provide excavations at the beginning and end terminals staging points of the horizontal bore-hole.
 - d. Provide full-depth “shoring” of the vertical pilot excavations. Remove the shoring, backfill, compact and repair the excavations when conduit installation is complete.
 - e. “Drilling-fluid” shall be used during “back-reaming” and “pullback”, pumped through the drill pipe to the bore drill head.
 - f. Directional guided horizontal drilling shall employ equipment specifically designed and manufactured for the process. The Equipment Manufacturer shall train bore equipment operating personal in the proper operation of said equipment.
 - g. Locate the position, size, depth and identify all underground “cross-bore” existing underground utilities, pipes, structures and conflicts along the entire bore path of each underground bore, prior to initiating directional boring work. Notify respective agency for each “cross bore” potential crossing. Comply with the recommendations of the Cross Bore Safety Association (CBSA).
 - h. Horizontal, directionally guided boring equipment, as manufactured by Ditch Witch; Vermeer Manufacturing; or Case Corporation.

J. Conduit Seals

1. Provide conduit seal fittings at each location where a conduit transitions or passes through the following areas and where indicated on the Drawings:
 - a. Refrigerated areas.
 - b. Temperature control rooms including warming rooms, steam rooms, saunas etc.
 - c. Classified hazardous material areas.
 - d. Water intrusion areas.
2. Provide conduit seals on each conduit entering a building from a below grade area located outside the building (i.e., basement, vault etc.) and connecting to the following types of equipment
 - a. Transformers
 - b. Panelboards
 - c. Motor control centers

- d. Switchboards
 - e. Switchgear
 - f. Motors
 - g. Terminal cabinets
 - h. Terminal backboards
 - i. Cable trenches
3. Conduit seals shall be installed in locations where the fitting is visible and accessible.
- K. Nailing Shields
- 1. Provide "nail" shields where FMC conduit and conductors not installed in a conduit are installed through wood stud and wood frame construction. The nail shield shall provide a barrier resistant to "nailing" fasteners through the stud, and penetrating into the FMC and conductors.
 - 2. The nail shields shall be flat nominal 1.5-inch by 3-inches, 14-gauge steel, and hot dip zinc galvanized with "nailing spurs".
 - 3. Provide nailing shields on the front face and rear face of each FMC penetration. The shield shall be centered on each penetration through the respective framing, stud framing blocking, and stud framing plates.
- L. Conduit Bodies
- 1. Conduit bodies shall be installed in exposed conduit locations only or above accessible ceilings.
 - 2. Conduit bodies shall be accessible for removing body cover and pulling wire through the conduit body.
 - 3. Conduit bodies shall not be installed inside enclosed walls.
- M. Preparation of Reuse of Existing Conduits
- 1. Prepare existing conduits shown to be reused as part of Contract Work as follows: Complete the required work prior to installing any conductors or cables in respective existing conduits.
 - a. "Rod" out existing raceways to be used under this contract, with approved test and flexible mandrels to remove all obstructions to clear debris from inside conduits.
 - b. Use test mandrels at least 12-inches long, 0.25-inch less than diameter of duct at center, tapering to 0.5-inch less than duct size at ends.
 - 2. If test mandrels cannot be pulled through raceways, Contractor shall perform the following to clear the existing raceways:
 - a. Force rigid or semi-rigid rods through the raceways to clear the obstructions from one to both ends of the raceway.
 - b. Force a power driven rotating router device through the conduit from one or both ends of raceways. Device shall incorporate small diameter cutting blades. Repeat the "router" process in incremental stages to a cutting blade diameter approximately 1/8-inch smaller than the race-way inside diameter.
 - 3. After clearing the raceway of obstructions, pull a test mandrel or brush through the raceway to clear the remaining debris from the raceway.

3.04 WIRE AND CABLE

- A. Branch circuit and fixture joints for #10AWG and smaller wire shall be made with UL-approved connectors listed for 600 volts, approved for use with copper and/or aluminum wire. Connector to consist of a cone-shaped, expandable coil spring insert, insulated with a nylon shell and two wings placed opposite each other to serve as a built-in wrench or shall be molded one-piece as manufactured by 3M-"Scotchlok".
- B. Branch circuit joints of #8AWG and larger shall be made with screw pressure connectors made of high strength structural aluminum alloy and UL-approved for use with both copper and/or aluminum wire as manufactured by Thomas & Betts. Joints shall be insulated with plastic splicing tape, tapered half-lapped and at least the thickness equivalent to 1.5-times the conductor insulation. Tapes shall be fresh and of quality equal to Scotch.
- C. Use UL listed pulling compound for installation of conductors in conduits.
- D. Correspond each circuit to the branch number indicated on the panel schedule shown on the Drawings except where departures are approved by the District's Representative.
- E. All wiring, including low voltage, shall be installed in conduit.
- F. Control wiring to conform to the wiring diagrams shown on the Mechanical Drawings and the Manufacturer's Wiring Diagrams.
- G. All splices in exterior pull boxes and light poles shall be cast resins encapsulated.
 - 1. Power conductor splices - 3M Scotchcast Series 82/85/90; Plymouth or equal.
 - 2. Control and signal circuits 3M Scotchcast Series 8981 through 8986, Plymouth or equal.
- H. Neatly group and lace all wiring in panelboards, motor control centers and terminal cabinets with plastic ties at 3-inch on centers. Tag all spare conductors.

3.05 CHEMICAL GROUND ROD

- A. General
 - 1. Install ground rod system in compliance with Manufacturer's instructions.
 - 2. Install rods vertically. Where subterranean hard rock conditions prevent vertical installation horizontal "L" shape ground rod shall be installed.
 - 3. Where ground rod is installed in an indoors dry location set ground box flush with finish floor. Where ground rod is installed outdoors set the top of the ground box 4-inches above finish grade.
 - 4. Do not remove sealing tape from ground rod holes until time of installation in ground.
 - 5. Separate ground rods from all other grounding electrodes and from each other by not less than 12-feet horizontal distance.
- B. Excavation
 - 1. Vertical installation bore a 12-inches diameter vertical hole in the ground 6-inches deeper than ground rod length.
 - 2. Horizontal installations excavate a 12-inches wide trench, slope rod and trench to insure end cap of rod is 2-inches lower than the elbow.

- C. Backfill
 - 1. Surround the entire rod with a minimum of 10 inches of bentonite clay mixed with water at 6-times volume to form a paste. Approximately 14-gallons for each 50-pounds of clay. Remove any excavation liners from the rod excavation area.
 - 2. Install ground box and complete backfill.
- D. Connect grounding electrode conductor(s) to ground rod.

3.06 CABLE RACKS

- A. General

Provide cable racks in precast and cast-in place concrete pullboxes, manholes and cable trenches.

3.07 TESTING

- A. Testing Conduit and Conduit Bends

The Contractor shall demonstrate the usability of all underground raceways and field fabricated conduit bends installed as part of this Contract.

 - 1. A round tapered segmented semi-rigid mandrel with a diameter approximately ¼-inch smaller than the diameter of the raceway, shall be pulled through each new raceway.
 - 2. The mandrel shall be pulled through after the raceway installation is completed. Conduits which stubout only, may have the mandrel pulled after the concrete encasement is completed, but prior to completing the backfill.
 - 3. District's Representative shall witness the raceway testing for usability. A Representative of the respective Utility Company shall witness the raceway testing where applicable.
 - 4. Contractor shall repair/replace any conduit and conduit bend provided under this Contract which will not readily pass the mandrel during this test.

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SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit Product Data Sheets.
- B. Submit Detailed Shop Drawings including Dimensioned Plans, Elevations, Details, Structural Calculations signed by a California State Registered Structural Engineer and descriptive literature for all component parts.

1.03 SECTION INCLUDES

- A. Concrete Encased Ductbanks where indicated on Contract Drawings.
- B. Trenching, Backfilling, Compacting, and Concrete Encasement for all 600V, 4.16kV and 12kV Ductbanks shall be required.

1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavating and Backfilling for Utilities: Division 31.
- B. Concrete: Division 03.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Duct, Fittings and Spacers:
 - 1. Carlon, an Indian Head Co.
 - 2. Queen City Plastics, Inc.
 - 3. Robintech Inc.
 - 4. R & G Sloane Manufacturing Co. Inc.
 - 5. Allied Tube and Conduit.

2.02 MATERIAL AND FABRICATION

- A. PVC Duct Schedule 40 (UL listed only): Manufactured in accord with NEMA Standard TC-2 and WC-1094 Specifications.
 - 1. Cemented fittings.
 - 2. Spacers: Vertical and horizontal interlocking duct spacers for concrete encasement: High-impact styrene.
 - 3. Riser sweeps for power and communication ducts shall be rigid galvanized steel or Schedule 80 PVC.
- B. Rigid Steel Conduit, Elbows and Nipples:
 - 1. Threaded, hot-dipped galvanized conduit manufactured in accord with ANSI C80.1 and UL 6.
 - 2. Threaded, hot-dipped galvanized fittings manufactured in accord with ANSI C80.4.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Excavate in Accord with Division 31.
- B. Exercise Care in Excavating, Trenching, and Working near Existing Utilities.
- C. Installation of Ductbanks:
 - 1. Ductbanks for primary electrical power and communication systems shall consist of multiple, single, round bore ducts. Ducts shall consist of PVC Schedule 40 conduits, UL approved only. All fittings and couplings shall be of the same type and Manufacturer of the duct, with UL approval.
 - 2. Galvanized steel conduits installed below grade shall be painted with two coats of Koppers bitumastic paint before installing in ground.
 - 3. All conduit risers into switchgear pad, transformer pad, communication pull boxes or enclosures shall be galvanized steel and have a radius of 60-inches minimum, unless indicated otherwise on Drawings.
 - 4. Concrete encased ductbank shall be completely encased in a minimum of 3 inches of concrete. Concrete shall be Class "B" red tint for 4.16kV and 12kV power and green tint for communication (6 lb. tint per cu. yd.), 2500 psi at 28 days. Ductbanks shall be of a monolithic construction top to bottom and side to side, but not necessarily end to end. All PVC duct shall be protected prior to installation.
 - 5. Prefabricated, interlocking intermediate and base spacers for Schedule 40 PVC conduit shall be used made of Specification grade high-density polyethylene. Spacers shall be installed not more than 5 feet center-to-center along entire length of ductbank. Each conduit shall be supported by spacers.
 - 6. At connection to manholes, dowel concrete encasement with one No. 4 reinforcing bar 36 inches long per duct.
 - 7. Ductbanks shall be securely anchored to prevent movement during placement of concrete.

8. Where connection to bulkhead of ductbank is made to vaults or existing ductbanks, the concrete encasement shall be doweled with one No. 4 reinforcement rod 36 inches long per conduit to the existing encasement.
9. Ductbank trench shall be shored, framed and braced for installing ducts. Frames, forms, and braces shall be either wood or steel. Variations in outside dimensions of the completed ductbank shall not exceed 2 inches on the vertical or the horizontal from dimensions shown on Drawings. Remove all forms and bracing after 24 hours and before backfilling.
10. Do not place backfill for a period of at least 24 hours after pouring of concrete.
11. Ductbanks shall be laid to a minimum grade slope of 4 inches per 100 feet. This slope may be from one manhole to the next or both ways from a high point between manholes, depending upon the contour of the finished grade. See respective Profile Drawings.
12. Ductbanks shall be installed so that the top of the concrete encasement shall be not less than 48 inches below finished grade or pavement for primary 12 kV power, and not less than 36 inches below finished grade or pavement for 5 kV power.
13. Changes in direction of runs either vertical or horizontal shall be accomplished by long sweep bends having a minimum radius of curvature of 30 feet, except that manufactured long radius bends may be used in runs of 100 feet or less on approval from Owner.
14. Duct joints in concrete encasement may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. All joints shall be made in accord with Manufacturer's recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, various types of duct joints shall be made by the following method:
 - a. Plastic duct connections shall be made by brushing a plastic-solvent cement on the inside of a plastic coupling fitting and on the outside of duct's ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.
15. The electrical system ground conductor shall be a minimum No. 4/0 AWG bare stranded copper cast in ductbank 3 inches below top of concrete, entering each manhole, and grounded to a rod using exothermic method as indicated on Drawings. The electrical system ground shall be connected to substations ground loops. A minimum of 15 feet pigtail shall be provided at each stub-up location noted on Drawings.
16. After the duct line has been completed, three each nonflexible mandrels not less than 12 inches long having a diameter approximately ¼-inch less than inside diameter of the duct shall be pulled through each duct; after which a brush with stiff bristles shall be pulled through each duct to make certain that no particles of earth, sand or gravel have been left in the line. Leave a 3/8-inch minimum polypropylene pull rope in each duct for future use.
17. Underground utilities marking: Install in accord with Division 31.

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SECTION 26 05 48
SOUND CONTROL

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Comply with pertinent provisions of Division 26.
- B. Submit product data sheets for vibration isolation devices.
- C. Submit Detailed Shop Drawings including Dimensioned Plans, showing equipment vibration isolation anchoring.

PART 2 - PRODUCTS AND EXECUTION

2.01 QUIETNESS OF OPERATION

Before the work will be accepted as complete, quietness of operation, to a degree satisfactory to the Architect shall be attained for apparatus, equipment, fixtures, etc., included under the electrical work. Provide isolation and vibration protection required.

2.02 VIBRATION ISOLATION FOR ELECTRICAL EQUIPMENT

- A. Objective: It is the objective of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or transformers, and/or due to interconnected conduit.
- B. Contractor Responsibility
 - 1. Provide a submittal to the Architect for review prior to any installation of his equipment, containing the following information:
 - a. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with the Specification.
 - b. An itemized list showing the items of equipment to be isolated, the isolator loading and deflection and isolator placement.
 - c. Drawings showing methods for attachment of conduit to motors.
 - 2. Furnish and install the vibration isolation devices as specified herein.

3. Do not install any equipment or conduit as specified in the schedule, which makes rigid contact with the "building" unless it is approved in this Specification, or by the Architect. "Building" includes slabs, beams, studs, walls, lath, etc.
4. Coordinate work with other trades to avoid rigid contact between equipment and/or conduit as specified in the schedule and the building. Inform other trades following his work, such as plastering, to avoid any contact that would reduce the vibration isolation.
5. Bring to the Architect's attention, prior to installation, any conflicts with other trades which will result in unavoidable contact to the equipment or conduit as specified in the schedule, described herein due to adequate space, etc. Corrective work necessitated by conflicts after installation shall be at the responsible Contractor's expense.
6. Bring to the Architect's attention any discrepancies between the specifications and field conditions, changes required due to installation. Corrective work necessitated by discrepancies after installation shall be at the Contractor's expense.
7. Obtain approval from the Architect of any installation to be covered on enclosed, prior to such closure.
8. Obtain written and/or oral instructions from the vibration isolation Manufacturer as to the proper installation and adjustment of vibration isolation devices.
9. Notify the Architect, prior to the general installation of vibration isolation devices, so that the Architect can instruct and demonstrate the technique of proper installation with the Contractor's Foreman.
10. Correct, at no additional cost, all installations, which are deemed to be defective workmanship or materials by the Architect.

2.03 VIBRATION ISOLATION TYPES

A. Isolator Description

1. Isolate all transformers with Type MN molded neoprene units equipped with leveling bolts and design status deflection under load of 0.3-inch.
2. Isolate all switchgear connected directly to transformer with Type PN isolators. Limit loading to a static deflection of 0.06 inch. Choose the area of pad to match the load with the Manufacturer's recommended unit loading. An auxiliary steel plate may be required to distribute the load uniformly over the pad area.

B. Equivalent Vibration Isolators

1.	Type Description	A	B	C	D	E	F	G
	Neoprene Mount							
	a) 0.2-inch max. deflection	N	FD	R	RV	CS	F	T-44
	b) 0.4-inch max. deflection	ND	FDD	RD	RFD	FU	RD	T-44
	PN Neoprene Pad	W	(1)	(2)	NR	R	(3)	100W
2.	Notes	Manufacturer's Code						
	(1) Elastogrip	A.	Mason Industries					
	(2) Shearflex	B.	Korfund					
	(3) Kinetic	C.	Vibration Mounting					
		D.	Amber/Booth					
		E.	Sausse					
		F.	Consolidated Kinetics					

G. Vibration Eliminator

2.04 CONDUIT INSTALLATION

- A. Provide flexible conduit or an approved vibration isolation device between any transformer and the building structure.
- B. Secure all electrical panels connected to transformers by flexible conduit to the floor. Do not contact stud or masonry partitions. Isolate panels from the floor as specified herein.
- C. Provide flexible conduit connections to all connections to air conditioning, plumbing, etc., or any rotating or oscillating equipment requiring electrical motors. Base the length of flexible conduit required for each motor upon the Requirements for a 360 degree loop in the conduit between the electrical motor and electrical box.
- D. As an alternative to the 360 degree loop, a Neoprene or rubber bushing between the conduit and the electric motor to break the metal-to-metal contact may be used. Provide a flexible ground strap to complete the electrical ground.

2.05 DEVICE OUTLET BOXES (INSTALLED IN COMMON PARTY SEPARATION WALLS, IN CORRIDOR WALLS AND SERVICE WALLS)

Device outlet boxes installed in walls shall be sealed on the exterior back and sides of the boxes, including wall openings around the box, with a 1/8-inch minimum thickness resilient sound absorbing, sealant. The sealant shall be free of asbestos, temperature rated from -30°F to 200°F, self-adhesive to metal and plastics, as manufactured by Lowry and Associates Inc., Sun Valley, California or equal.

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SECTION 26 09 10
SUPPLEMENTAL METERING AND SUB-METERING

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Provide Schematic Control Wiring Diagrams and "Point-to-Point" control wiring diagrams showing control and protective systems interlocks.
- B. Provide Nameplate Engraving Schedule.

1.03 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

- A. The Equipment shall be designed, tested and assembled to comply with ANSI, IEEE and NEMA and UL.
 - 1. UL 1244 Electrical and Electronic Measuring and Test Equipment.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Function
 - 1. Electronic digital metering, microprocessor based data measurement and data recording of simultaneous occurring continuously operating analog conditions, simultaneously with data recording of individual occurrence instantaneous events.
 - 2. The supplemental metering is secondary to the utility revenue metering, as separate independent sub-metering systems. Shall provide tracking of the status, consumption and flow of the unit-values monitored by the respective supplemental metering systems.
 - 3. The meters shall connect analog to digital, not less than 24-bit analog to digital conversion, certified to National Accuracy Standards. UL listed and labeled. Provide local readable visual meter displays, local digital data storage and digital data communications with remote locations.
 - 4. Measurement accuracy shall be better than 0.5% and comply with IEC687 (Class 0.5%) and ANSI C12.20 (Class 0.5%). Combined meter and current transformers and related software systems operational accuracy for the electrical power sub-metering systems shall comply with ANSI-C 12.20 and the Public Utility Commission revenue grade accuracy compliance. The sub-metering systems accuracy shall also comply with Savings-

by-Design Program Requirements and U.S. Green Building Council Program Requirements, including but not limited to the following:

- a. +0.5% at 1.0 power factor and 1% through 100% of rated current.
 - b. $\pm 0.75\%$ at 0.5 power factor and 1% through 100% of rated current.
5. Front of meter operator control of meter functions.
 6. Ambient operating temperature range minus 15-degrees centigrade to plus 50-degree centigrade.
 7. Flammability rating UL94-5V, self-extinguishing, non-flame propagating.
- B. Sub-Metering Communications
1. Each meter shall provide full duplex bi-directional network communications. Shall provide connection ports for laptop portable computer/PDA and for remote data collection and monitoring.
 2. Provide the following wired meter network connections in each meter
 - a. EIA RS-485 serial port for direct connect locally at each meter.
 - b. IEEE compliant TCP/IP Fast Ethernet, with RJ-45 port connect and with Power-Over-Ethernet (POE) for remote communications at each meter.
 3. Meters shall record and store monitoring data in static non-volatile memory. Not less than 60-calendar days of memory storage capacity. The stored data shall be available for local display on operator demand at the meter and for downloading from the meter by the following.
 - a. Portable laptop computer/PDA connected (plug-in) to the meter communication port.
 - b. Metering communications network for Automatic Metering Reading-AMR from remote locations using the metering LAN network.
 4. Meter electrical operating power.
 - a. Provide meter internal electrical power supplies, batteries shall not be the source of normal meter electrical power.
 - b. Meters monitoring electrical power circuits shall connect to the monitored electrical circuit for meter operating power. Provide protective fusing.
 - c. Meters monitoring non-electrical systems shall operate on 120 volt 60Hz AC branch circuit electrical power.
 5. Bi-directional monitoring for Net-Metering applications.

2.02 ELECTRICAL POWER METERING

A. General

1. The meters shall be microprocessor controlled, digital, measuring and indicating meters.
2. Meter enclosure nominal size 8-inches x 8-inches by 4-inches deep, surface mounting, self-contained, dust proof, insulating electrical housing.
3. The meter shall be rated for direct circuit connects up to 600 volt AC. Single-Phase; Three-phase "WYE" or "Delta" to match the monitored circuit configuration. Provide bus-tap voltage, with current limiting 15-amp 3-pole circuit breaker or 2-pole circuit breaker, as applicable.

4. The meter shall accommodate input connect through split core instrument Current Transformers (CT). Provide a CT for each phase, compatible with the install location. Three CT's for three-phase systems and two CT's for single-phase systems.
 5. The meter shall be compatible with the input voltage, CT input/output ratios.
 6. Shall provide proper operation over distance of up to 100 feet meter wiring circuit length from the meter to the respective CT location.
 7. Meter Withstand Ratings:
 - a. Continuous current overload 100%.
 - b. Surge 10-times rating for 3-Seconds
 8. As manufactured by Electro Industries-Shark Series; or equal.
- B. Meter Monitoring and Measurements Range.
1. The meter shall provide multi-function monitoring for three-phase and single-phase as applicable.
 - a. Real time kilowatt kW load
 - b. Cumulative kilowatt hour kWh load
 - c. Peak kilowatt demand with time and date adjustable window of 15-minute or 30-minute intervals
 2. Direct-read at each meter location, 8-digit LCD visual display of measured data parameters.

2.03 AUTOMATIC METER READING-AMR

- A. General
1. Remote AMR communications data recovery and data analysis from the Sub-meters shall occur by the following methods:
 - a. Wired meter communications LAN network.
 - b. Typical for Switchboard Owner metering and Panelboard Owner metering.
 2. The monitor and communications software shall communicate with the Supplemental Metering and Sub-metering system using the AMR communications pathways.
 3. Provide meter LAN Network communications Gateway to translate metering system LAN communications protocols with the communications protocols for the Building Automation System BAS-EMCS. Coordinate with BAS EMCS.
 4. Provide communications port-card for the Supplemental Metering and Sub-metering system.

The port-card shall connect to the PC workstation computer. Operate and communicate with the metering system and the PC workstation monitoring/communicating metering software.
- B. Wired Meter Communications Meter LAN Network Pathway
1. Wired meter network operating over IEEE compliant TCP/IP Fast Ethernet LAN Network. ANSI/EIA/TIA Category-6, 4-pair UTP with RJ-45 connectors.

2.04 MONITORING AND COMMUNICATING SOFTWARE

A. General

1. The monitoring and communicating software shall provide a complete and comprehensive enterprise wide operation of the metering system. Provide concurrent multi-user software site license for the entire system.
2. Graphic User Interface (GUI) operation, programming and configuration of meters.
3. Real-time viewing capability, data-logging and viewing of historical logs.
4. Communication with sub-meters through Ethernet TCP/IP, direct (plug-in) Serial port, and remote RF Wireless. Shall operate on pc-computers with Microsoft-Windows® operating system.
5. Provide charting, graphing, and analysis of data. Provide viewing of sub-meter records with comprehensive data analysis.
6. ODBC databases for all collected data.
7. Meter reading full reporting capability, utilizing artificial intelligence to diagnose events and provide possible cause scenarios.
8. Client billing and invoice statements for monthly payment by Clients of consumed measure values.
9. Audible and email alarms of selected conditions.
10. WEB Internet access to all meter data.
11. Install, set up and program all software for a fully functional AMR system.

B. Software Functions

1. Connection between remote meters via Serial, Ethernet, RF wireless or Modem. Shall function with all the meters in the Supplemental Metering and Sub-meter system.
2. Viewing of real-time metered data, configuring of meters, and analyzing of collected information from the remote sub-meters.
 - a. View real-time readings of all measured parameters.
 - b. Configure and analyze collected data from remote sub-meters.
 - c. Collect and archive all data.
3. Computer screen display, graphing and reporting functions for collection and archiving of data. ODBC-compliant database structures, stored metering information integrated automatically into other 3rd party software packages. Shall also support .csv file format, auto-configurable.

Real-time viewing capability shall include:

- a. Volume, flow, voltage, current, power, and energy
- b. Time of usage and accumulations
- c. Alarms and limits
- d. Maximum and minimum for each parameter
- e. I/O device information

4. Real-time viewing of data in graphical format. Charting and graphing functions access to any desired data analysis.
 - a. Calculation of power quality on a scatter graph
 - b. CBEMA plotting information
 - c. 3D plots and histograms provided to aid in determining frequency and severity of monitored events.
 - d. Graphical data analysis by the base software.
 - e. Viewing of stored waveforms, events caused by monitored system problems, faults, transients, and other conditions.

C. Reports

1. Reporting software shall provide a comprehensive report on each meter, making use of Artificial Intelligence (AI) technology to diagnose the events and provide the possible cause of the event.
2. AI generated industry accepted solution as a result of the analysis of the monitored event. The AI program of the reporting software package shall make use of Fuzzy Logic, Neural Networks, embedded knowledge, and embedded rules to generate correct analysis and solutions.
3. Create tenant billing invoice statement for individual tenant consumption of measured values by the sub-metering system.
4. The software shall have a primary Reports server and a Standby Reports server. If the primary server is not running, the user shall be capable of connecting to the standby server.
5. User to specify report writing at project startup or other user-defined times, or on the occurrence of user-defined triggers or conditions.
6. User to specify report printing when run or saved to storage disk for later printing. The software shall allow user to format report variables.

D. Remote Server

1. Shall support the receiving of data strings from remote sub-meters in the field. The software shall check the monitoring system for connected remote sub-meters and assign incoming calls. Display warnings and to send email, pager, or phone notification of alarm conditions.

E. Security

1. The software shall have advanced security features, allowing password protection through up to five levels of privileges. The password protection shall allow restriction of access to specific screens and/or functions.
2. The operator shall be automatically logged out after a specified amount of inactivity time. The software shall still be active, but the user shall be restricted to 0 privilege level access after automatic logout.
3. Shall run as either a service or a shell under Microsoft Windows, to disable switching to other Windows applications while the software is running.
4. Allow disabling of the Ctrl-Alt-Delete shortcut key, to restrict operator access to other Windows applications.

5. Not less than two types of alarms: hardware alarms and configurable alarms. Issue alarms for devices going offline and other hardware conditions. User define alarm conditions for configurable alarms. Allow the following four types of configurable alarms: digital alarms, time-stamped alarms, analog alarms, and advanced alarms. Create a project page to display alarms and allow for operator intervention. Alarms must be able to be ordered into categories for prioritization and display.
 6. Online Help functions, including a complete Help guide, navigable with forward and back buttons, an Index, and a Search function. Shall have complete context-sensitive help in all of the development screens.
- F. Configuration
1. The software shall contain Wizards that allow quick and easy setup of configurable devices and the main control unit.
 2. Shall provide Genies already programmed for metering devices. These Genies shall be configured to access and show real-time readings.
 3. Shall contain pre-programmed tags for trending and graphing, reporting, events logging, and alarm conditions.
 4. The configuration mode shall use forms and templates for data entry during development.
 5. The configuration shall utilize Vectoral Graphics. The end user shall be capable of:
 - a. Importing graphics and editing them
 - b. Creating custom symbols and other objects and animating them, copying them, and moving them on the screen
 - c. Connecting symbols and objects and moving them around on the screen
 - d. Assigning tags to objects, such as metering devices, to display information and perform functions
 - e. Creating links to other screens and programs from devices and/or buttons
 - f. Assigning access rights to objects on the screen
 - g. Assigning keyboard commands to objects on the screen, activated by clicking on an object, moving over an object, or releasing a “click” on an object
 - h. Configuring objects to change when the project is in Runtime Mode, or when a pre-defined condition exists, e.g., a metering device has gone offline
 - i. Assigning actions consequent on an object being clicked
 - j. Configuring more than one project at a time, utilizing the same workstation

PART 3 - EXECUTION

3.01 INSTALLATION

- A. A Branch Circuit Breaker shall be provided at the metering location to allow safe access to metering components without powering down the entire electrical system.
- B. All Meters, Metering Equipment and Software shall be installed to comply with Manufacturer’s installation instructions and recommendations.

- C. Wiring Connects (Additional Requirements)
 - 1. Provide communication connections,
 - 2. One 0.75-inch conduit with two Category-6 cables, homerun to nearest IDF/MDF room patch panel.
 - a. From each meter location

3.02 SYSTEM COMMISSIONING AND START-UP

- A. Contractor to provide setup, testing and programming of metering system and “Commissioning”. Shall be performed prior to occupancy.
 - 1. Record the “cross reference” or the meter serial number (unique ID), meter point, to monitor load relationship.
 - 2. Check for power to the meter.
 - 3. Check the serial number inside the meter.
 - 4. Open the panel so that all CT’s are visible.
 - 5. Verify the CT ratio and write up the cross reference information for the meter.
 - 6. Confirm the “cross reference”. Turn on a known load in the respective monitor load unit on each phase.
 - 7. Verify the meter’s phase diagnostics for the assigned monitor load. Confirm that there is a significant increase on the load for each phase of the meter point.
 - 8. After phases have been checked and loads are still running, turn off the breaker serving the monitor load and confirm that all loads are disconnected.
- B. Test Results:
 - 1. Submit two draft copies of Test results to the Owner’s Representative.
 - 2. After approval submit the test results in two final printed copies and one computer readable copy.
- C. Testing shall include testing of Communications between Sub-meters, Communications modules, Transponders, and Remote monitoring AMR locations.
 - 1. Testing shall confirm that all power meters included in cross-reference are properly communicating.
 - 2. Testing shall confirm that remote connection is complete.
 - 3. Testing shall confirm that all Transponders and the networks are communicating properly.

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SECTION 26 09 43
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Digital-Network Lighting Control System and Associated Components:
 - 1. Power panels.
 - 2. LED drivers.
 - 3. Lighting control modules (Lutron EnergiSavr Node).
 - 4. Lighting management hubs.
 - 5. Lighting management system computers.
 - 6. Lighting management system software.
 - 7. Control stations.
 - 8. Low-voltage control interfaces.
 - 9. Wired sensors.
 - 10. Wireless sensors.
 - 11. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 00 – Common Work Results for Electrical
- B. Section 26 50 00 – Lighting Fixtures

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; Code of Federal Regulations; current edition.
- B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.
- C. ANSI/ESD S20.20 - Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices).
- D. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments
- E. CAL TITLE 24 P6 - California Code of Regulations, Title 24, Part 6 (California Energy Code).
- F. IEC 60669-2-1 - Switches for Household and Similar Fixed Electrical Installations - Part 2-1: Particular Requirements - Electronic Switches.
- G. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements.
- H. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test.

- I. IEC 61000-4-5 - Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test.
- J. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- K. ISO 9001 - Quality Management Systems-Requirements.
- L. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- M. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association.
- N. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association.
- O. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.
- P. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- R. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- S. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- T. UL 508A - Industrial Control Panels; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- U. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- V. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- W. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- X. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other Sections or by others.
 2. Coordinate the placement of wall controls with actual installed door swings.
 3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other Sections or by others.
 4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.

5. Notify Architect of any conflicts or deviations from the Contract Documents to obtain direction prior to proceeding with work.
- B. Pre-Wire Meeting: Conduct on-site meeting with Lighting Control System Manufacturer prior to commencing work as part of Manufacturer's standard startup services. Manufacturer to review with Installer:
1. Low Voltage Wiring Requirements.
 2. Separation of power and low voltage/data wiring.
 3. Wire labeling.
 4. Lighting management hub locations and installation.
 5. Control locations.
 6. Computer jack locations.
 7. Load circuit wiring.
 8. Network Wiring Requirements.
 9. Connections to other equipment and other Lutron equipment.
 10. Installer responsibilities.
 11. Power panel locations.
- C. Sequencing:
- Do not install sensors and wall controls until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures in Division 01 General Requirements.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, Service Condition Requirements, and installed features.
 1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.
- C. Shop Drawings:
 1. Provide schematic system riser diagram indicating component interconnections. Include Requirements for interface with other systems.
 2. Provide detailed sequence of operations describing system functions.
- D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by Product Testing Agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Title 24 Acceptance Testing Documentation: Submit Certification of Acceptance and associated documentation for lighting control acceptance testing performed in accordance with CAL TITLE 24 P6, as specified in Part 3 under "COMMISSIONING".
- F. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

- G. Warranty: Submit Sample of Manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Owner's name and registered with Manufacturer.

1.06 QUALITY ASSURANCE

- A. Conform to Requirements of NFPA 70.
- B. Maintain at the Project Site a copy of each referenced document that prescribes Execution Requirements.
- C. Manufacturer Qualifications:
 - 1. Company with not less than 10-years of experience manufacturing lighting control systems of similar complexity to specified system.
 - 2. Registered to ISO 9001, including in-house engineering for product design activities.
 - 3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.
- D. Title 24 Acceptance Testing Technician Qualifications: Certified by a California approved Acceptance Test Technician Certification Provider (ATTCP) as an Acceptance Test Technicians (ATTs) in accordance with CAL TITLE 24 P6.

1.07 DELIVERY, STORAGE, AND HANDLING

Store products in a clean, dry space in Original Manufacturer's packaging in accordance with Manufacturer's written instructions until ready for installation.

1.08 WARRANTY

- A. See Section 01 74 00 - Warranties and Guarantees under Division 01 General Requirements.
- B. Manufacturer's Standard Warranty, with Manufacturer Start-Up; Lutron Standard 2-year Warranty; Lutron LSC-B2:
 - 1. Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers and Ballast Modules:
 - a. First Two Years:
 - 1) 100% replacement parts coverage, 100% Manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
 - 2) First-available on-site or remote response time.
 - 3) Remote diagnostics for applicable systems.
 - b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding Manufacturer holidays.
 - 2. Lighting Management System Computer: One year 100% parts coverage, 1-year 100% Manufacturer labor coverage.
 - 3. Ballasts/Drivers and Ballast Modules: 5-years 100% parts coverage, no Manufacturer labor coverage.

- C. Include as part of the base bid additional costs for Manufacturer's Enhanced Warranty with Manufacturer Start-up; Silver Enhanced Warranty; Lutron LSC-E8S; coverage to include items listed under Manufacturer's standard warranty with Manufacturer start-up above, plus the following upgrades:
 - 1. Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers and Ballast Modules:
 - a. First Two Years:
 - 1) As-available Field Service response; no committed response time.
 - b. Additional Coverage for year's 3-5: 50% replacement parts coverage, no Manufacturer labor coverage.
 - c. Additional Coverage for year's 6-8: 25% replacement parts coverage, no Manufacturer labor coverage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer: Lutron Electronics Company, Inc.; www.lutron.com.
- B. Substitutions:
 - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect a minimum of 10 working days prior to the bid date and must be made available to all Bidders. Proposed substitutes must be accompanied by a review of the Specification noting compliance on a line-by-line basis.
 - 2. By using pre-approved substitutions, Contractor accepts responsibility and associated costs for all required modifications to related equipment and wiring. Provide complete Engineered Shop Drawings (including power wiring) with deviations from the original design highlighted in an alternate color for review and approval by Architect prior to rough-in.

2.02 DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

- A. Sensor Layout and Tuning: No Lighting Control Manufacturer Sensor Layout and Tuning service to be provided; Lutron LSC-NO-SENS-LT.
 - 1. Contractor to utilize Lighting Control Manufacturer Installation Instructions to place/install sensors.
 - 2. At Pre-wire and Startup, Lighting Control Manufacturer to provide a rough sensor calibration only. Sensor fine-tuning to be the responsibility of Contractor.
- B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.
- C. 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.
- D. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90% non-condensing relative humidity.

- E. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
- F. Dimming and Switching (Relay) Equipment:
 - 1. Designed so that electrolytic capacitors operate at least 36 degrees F (20 degrees C) below the capacitor's maximum temperature rating when the device is under fully loaded conditions at maximum rated temperature.
 - 2. Inrush Tolerance:
 - a. Utilize load-handling thyristors (SCRs and triacs), Field Effect Transistors (FETs) and Isolated Gate Bipolar Transistors (IGBTs) with maximum current rating at least two times the rated operating current of the dimmer/relay.
 - b. Capable of withstanding repetitive inrush current of 50 times the operating current without impacting lifetime of the dimmer/relay.
 - 3. Surge Tolerance:
 - a. Panels: Designed and tested to withstand surges of 6,000 V, 3,000-amp according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.
 - b. Other Power Handling Devices: Designed and tested to withstand surges of 6,000 V, 200-amp according to IEEE C62.41.2 without impairment to performance.
 - 4. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
 - 5. Dimming Requirements:
 - a. Line Noise Tolerance: Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2% change in RMS voltage per cycle), frequency shifts (plus or minus 2Hz change in frequency per second), dynamic-harmonics, and line noise.
 - 1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
 - b. Incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
 - c. Utilize air gap off to disconnect the load from line supply.
 - d. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
 - e. Load Types:
 - 1) Assign a load type to each dimmer that will provide a proper dimming curve for the specific light source to be controlled.
 - 2) Provide capability of being field-configured to have load types assigned per circuit.
 - f. Minimum and Maximum Light Levels: User adjustable on a circuit-by-circuit basis.
 - g. Line Voltage Dimmers:
 - 1) Dimmers for Magnetic Low Voltage (MLV) Transformers:
 - a) Provide circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
 - b) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.

- 2) Dimmers for Electronic Low Voltage (ELV) Transformers: Operate transformers via reverse phase control. Alternately, forward phase control dimming may be used if Dimming Equipment Manufacturer has recommended specific ELV transformers being provided.
- 3) Dimmers for Neon and Cold Cathode Transformers:
 - a) Magnetic Transformers: Listed for use with normal (low) power factor magnetic transformers.
 - b) Electronic Transformers: Must be supported by the Ballast Equipment Manufacturer for control of specific ballasts being provided.
- h. Low Voltage Dimming Modules:
 - 1) Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to a single zone.
 - 2) Single low voltage dimming module; capable of controlling the following light sources:
 - a) 0-10V analog voltage signal.
 - Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
 - Sink current according to IEC 60929.
 - Source current.
 - b) 10-0V reverse analog voltage signal.
 - c) DSI digital communication.
 - d) DALI broadcast communication per IEC 60929:
 - Logarithmic intensity values complying with IEC 60929.
 - Linear intensity values for use with LED color intensity control.
 - e) PWM per IEC 60929.
6. Switching Requirements:
 - a. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16A for all lighting loads.
 - b. Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - c. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.
- G. Device Finishes:
 1. Standard Colors: Comply with NEMA WD1 where applicable.
 2. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.
 3. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.03 POWER PANELS

- A. Provide power panels with configurations as indicated on the Drawings.
- B. General Requirements:
 1. Listed to UL 508 as industrial control equipment.
 2. Comply with UL 508A and IEC 60669-2-1 as applicable.
 3. Delivered and installed as a listed factory-assembled panel.

4. Field wiring accessible from front of panel without removing dimmer assemblies or other components.
5. Passively cooled via free-convection, unaided by fans or other means.
6. Shipped with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.
7. Provided with branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the Drawings.
8. Branch Circuit Breakers:
 - a. Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
 - b. Provided with visual trip indicator.
 - c. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
 - d. Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of panel.
 - e. Equipped with provision for tag-out/lock-out devices to secure circuit breakers in off position when servicing loads.
 - f. Replaceable without moving or replacing dimmer/relay assemblies or other panel components.
 - g. Listed as Switch Duty (SWD) so that loads can be switched on and off by breakers.
9. Provide panels with listed short circuit current rating not less than the available fault current at the installed location as indicated on the Drawings.
10. Panel Processor; Lutron Circuit Selector:
 - a. Provide the following capabilities:
 - 1) Operate circuit directly from panel processor for system diagnostics and provide feed-back of system operation.
 - 2) Electronically assign each circuit to any zone in lighting control system.
 - 3) Determine normal/emergency function of panel and set emergency lighting levels.
 - b. React to changes from control within 20 milliseconds.
11. Diagnostics and Service:
 - a. Replacing dimmer/relay does not require re-programming of system or processor.
 - b. Include diagnostic LEDs for dimmers/relays to verify proper operation and assist in system troubleshooting.
 - c. Include tiered control scheme for dealing with component failure that minimizes loss of control for occupant.
 - 1) If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.

- 2) If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.
- 3) If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

C. Product(s):

1. Relay Panels:
 - a. Product: Lutron XP Series Switching Panels.
 - b. Provide surface-mounted or flush-mounted enclosures as indicated.
 - c. Switching Requirements:
 - 1) Utilize 20A continuous-use rated switching modules; able to switch 20 A receptacles.
 - 2) Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
 - 3) Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - 4) Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

2.04 LED DRIVERS

A. General Requirements:

1. Operate for at least 50,000 hours at maximum case temperature and 90% non-condensing relative humidity.
2. Provide thermal fold-back protection by automatically reducing power output (dimming) to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that approach or exceed the LED driver's maximum operating temperature at calibration point.
3. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.
4. Designed and tested to withstand electrostatic discharges incurred during manufacturing, installation, or field troubleshooting without impairment of performance when tested according to IEC 61000-4-2.
5. Manufactured in a facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.
6. UL 8750 recognized or listed as applicable.
7. UL Type TL rated where possible to allow for easier fixture evaluation and listing of different driver series.
8. UL 1598C listed for field replacement as applicable.
9. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
10. Class A sound rating; inaudible in a 27 dBA ambient.

11. Demonstrate no visible change in light output with a variation of plus or minus 10% change in line-voltage input.
 12. LED drivers of the same family/series to track evenly across multiple fixtures at all light levels.
 13. Offer programmable output currents in 10 mA increments within designed driver operating ranges for custom fixture length and lumen output configurations, while meeting a low-end dimming range of 100% to 1% or 100% to 5% as applicable.
 14. Meet NEMA 410 Inrush Requirements.
 15. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in the event of incorrect application of line-voltage to communication link inputs.
 16. LED driver may be remote located up to 100 feet (30 m) from LED light engine depending on power outputs required and wire gauge utilized by Installer.
- B. Digital Control (when used with compatible Lutron lighting control systems):
1. Employ power failure memory; LED driver to automatically return to the previous state/ light level upon restoration of utility power.
 2. Operate from input voltage of 120 V through 277 V at 50/60Hz.
 3. Automatically go to 100% light output upon loss of control link voltage and lock out system commands until digital control link voltage is restored. Manufacturer to offer UL 924 compliance achievable through use of external Lutron Model LUT-ELI-3PSH interface upon request.
 4. Each driver responds independently per system maximum:
 - a. Up to 32 occupant sensors.
 - b. Up to 16 daylight sensors.
 5. Responds to digital load shed command. (Example: If light output is at 30% and a load shed command of 10% is received, the ballast automatically sets the maximum light output at 90% and lowers current light output by 3% to 27%).
 6. Digital low-voltage control wiring capable of being wired as either Class 1 or Class 2.
- C. Product(s):
1. Digital Control, 5% Dimming; Lutron 5-Series (LDE5-Series):
 - a. Dimming Range: 100% to 5% measured output current.
 - b. Typically dissipates 0.2 W standby power at 120V and 0.3 W standby power at 277V.
 - c. Complies with FCC Requirements of CFR, Title 47, Part 15, for commercial applications at 120/277V.
 - d. Constant Current Reduction (CCR) dimming method.
 - e. Total Harmonic Distortion (THD): Less than 21% at full load; complies with ANSI C82.11.
 - f. Constant Current Drivers:
 - 1) Support for downlights and pendant fixtures in select currents from 350 mA to 1.4 A to ensure a compatible driver exists.
 - a) Support LED arrays up to 35 W.
 - b) Models available that Meet Requirements for Energy Star compliance.

- 2) Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 2.1 A to ensure a compatible driver exists.
 - a) Support LED arrays up to 75 W.
 - b) Models available to meet the Design Lights Consortium (DLC) Power Line Quality Requirements.
- 2. Digital Control, 1% Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume 1% Soft-on Fade-to-Black (LDE1-Series):
 - a. Dimming Range: 100% to 1% measured output current.
 - b. Features smooth fade-to-on and fade-to-black (Lutron Soft-On, Fade-to-Black) low end dimming performance for an incandescent-like dimming experience.
 - c. Typically dissipates 0.2 W standby power at 120V and 0.3 W standby power at 277V.
 - d. Complies with FCC Requirements of CFR, Title 47, Part 15, for commercial applications at 120/277V.
 - e. Employs true Constant Current Reduction (CCR) dimming method from 100 to 5% light level and Pulse Width Modulation (PWM) dimming method from 5% to off.
 - f. Pulse Width Modulation (PWM) frequency of 240 Hz.
 - g. Total Harmonic Distortion (THD): Less than 20% at full output for drivers greater than 25 W; complies with ANSI C82.11.
 - h. UL Class 2 output.
 - i. Driver outputs to be short circuit protected, open circuit protected, and overload protected.
 - j. Constant Current Driver; Lutron K-Case Form Factor: Support for fixtures from 220 mA to 1.4 A over multiple operating ranges.
 - 1) Support LED arrays up to 40 W.
 - 2) Models available that Meet Requirements for Energy Star compliance.
 - k. Constant Current Driver; Lutron M-Case Form Factor: Support for fixtures from 150 mA to 2.1 A over multiple operating ranges.
 - 1) Support LED arrays up to 75 W.
 - 2) Models available to meet the Design Lights Consortium (DLC) Power Line Quality Requirements.

2.05 LIGHTING CONTROL MODULES (LUTRON ENERGY SAVER NODE)

- A. Provide lighting control modules as indicated or as required to control the loads as indicated.
- B. General Requirements:
 - 1. Listed to UL 508 as industrial control equipment.
 - 2. Delivered and installed as a listed factory-assembled panel.
 - 3. Passively cooled via free-convection, unaided by fans or other means.
 - 4. Mounting: Surface.
 - 5. Connection without interface to wired:
 - a. Occupancy sensors.
 - b. Daylight sensors.
 - c. IR receivers for personal control.

6. Connects to lighting management hub via RS485.
 7. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
 8. Contact Closure Input:
 - a. Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
 - 1) Activate scenes.
 - a) Scene activation from momentary or maintained closure.
 - 2) Enable or disable after hours.
 - a) Automatic sweep to user-specified level after user-specified time has elapsed.
 - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level.
 - c) Occupant can reset timeout by interacting with the lighting system.
 - 3) Activate or deactivate demand response (load shed).
 - a) Load shed event will reduce lighting load by user-specified amount.
 9. Emergency Contact Closure Input:
 - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
 - b. Allow configurable zone response during emergency state.
 - c. Disable control operation until emergency signal is cleared.
 10. Supplies power for control link for keypads and control interfaces.
 11. Distributes sensor data among multiple lighting control modules.
 12. Capable of being controlled via wireless sensors and controls.
- C. 0-10V Lighting Control Modules:
1. Product(s):
 2. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
 3. Single low voltage dimming module; capable of controlling following light sources:
 - a. 0-10V analog voltage signal.
 - 1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
 - 2) Sink current per IEC 60929.
 - b. 10V-0V analog voltage signal.
 - 1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
 - 2) Sink current per IEC 60929.
 4. Switching:
 - a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
 - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

- d. Module to integrate up to four individually controlled zones.
 - e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
- D. Digital Fixture Lighting Control Modules:
- 1. Product(s):
 - a. Lutron EcoSystem Energi Savr Node; Model QSN-1ECO-S: One EcoSystem Digital Link.
 - b. Lutron EcoSystem Energi Savr Node; Model QSN-2ECO-S: Two EcoSystem Digital Links.
 - 2. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
 - 3. Provide testing capability using manual override buttons.
 - 4. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

2.06 LIGHTING MANAGEMENT HUBS

- A. Product: Lutron Quantum Light Management Hub.
- B. Provided in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- C. Connects to controls and power panels via RS485.
- D. Enables light management software to control and monitor compatible dimming ballasts and ballast modules, power panels, power modules, and window treatments.
 - 1. Utilizes Ethernet connectivity to light management computer utilizing one of the following methods:
 - a. Dedicated network.
 - b. Dedicated VLAN.
 - c. Shared network with Building Management System (BMS).
 - d. Corporate network where managed switches are configured to allow multicasting and use of IGMP.
- E. Integrates control station devices, power panels, shades, preset lighting controls, and external inputs into a single customizable lighting control system with:
 - 1. Multiple Failsafe Mechanisms:
 - a. Power failure detection via emergency lighting interface.
 - b. Protection: Lights go to full on if ballast wires are shorted.
 - c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
 - 2. Manual overrides.
 - 3. Automatic control.
 - 4. Central computer control and monitoring.
 - 5. Integration with BMS via BACnet.
- F. Furnished with astronomical time clock.

- G. Maintains a backup of the programming in a non-volatile memory capable of lasting more than 10-years with-out power.
- H. BACnet Integration License:
 - 1. Provide ability to communicate by means of native BACnet IP communication (does not require inter-face) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
 - 2. Requires only one network connection per system.
 - 3. Lighting control system to be BACnet Test Laboratory (BTL) listed.
 - 4. Basic BACnet integration license:
 - a. The BACnet integrator can command:
 - 1) Area light output.
 - 2) Area enable or disable after hours mode.
 - 3) Area load shed level.
 - 4) Area load shed enable/disable.
 - 5) Enable/Disable:
 - a) Area occupancy sensors.
 - b) Area daylighting.
 - 6) Daylighting level.
 - 7) Area occupied and unoccupied level
 - 8) Occupancy sensor timeouts.
 - b. The BACnet integrator can monitor:
 - 1) Area on/off status.
 - 2) Area occupancy status.
 - 3) Area fault.
 - a) Lamp failures.
 - b) Control devices not responding.
 - 4) Area load shed status.
 - 5) Area instantaneous energy usage and maximum potential power usage.
 - 6) Energy savings broken out by strategy (occupancy, timeclock, daylighting, personal control, tuning, load shed) down to the individual area.
 - 7) Enable/Disable:
 - a) Area occupancy sensors.
 - b) Daylighting.
 - c) Timeclocks.
 - 8) Daylighting level.
 - 9) Light levels from photo sensors or Radio Window sensors.
 - 10) Area occupied and unoccupied level.
 - 11) Occupancy sensor timeouts.
 - 5. Integration with other devices over Ethernet via Telnet using the Lutron Integration Protocol.
 - 6. Control other devices over Ethernet via TCP or Telnet by sending device specific strings.

2.07 LIGHTING MANAGEMENT SYSTEM COMPUTERS

A. Computers:

1. Product: Lutron Q-Manager.
2. System PC (Desktop/Laptop):
 - a. Suitable for occasional programming, monitoring, and control of digital network lighting controls.
 - b. Unless otherwise indicated, computer(s) to be provided by others, meeting Lighting Control System Manufacturer's Minimum Requirements.
 - c. Minimum Hardware Requirements:
 - 1) Processor: Single Intel® Core® i3 processor with minimum speed of 2.4 GHz.
 - 2) 4 GB RAM.
 - 3) 250 GB hard drive (40 GB for application).
 - 4) One 10/100/1000 Ethernet network interface for communication with lighting management hubs.
 - 5) Monitor with 1280 x 1024 resolution.
 - 6) 4 USB 2.0 ports.
 - 7) Dedicated Graphics Card with 256 MB of memory.
 - d. Minimum Software Requirements:
 - 1) Licensed installation of US English 64-bit Microsoft® Windows® 7 Professional with Service Pack 1, US English 64-bit Microsoft® Windows® 8 Professional, or US English 64-bit Microsoft® Windows® 8.1 Professional.
 - 2) Microsoft® Internet Information Services (IIS) 7 or later.
 - 3) Microsoft® Internet Explorer 9 or later.
 - 4) Microsoft® .NET Framework 3.5.
 - 5) Microsoft® .NET Framework 4.5.
3. Server:
 - a. Suitable for 24 hour per day, 7 day per week programming, monitoring, control, and data logging of digital-network lighting controls.
 - b. Suitable to handle client machine request in multi-computer systems.
 - c. Unless otherwise indicated, computer to be provided by others, meeting Lighting Control System Manufacturer's minimum Requirements.
 - d. Minimum Hardware Requirements:
 - 1) Processor: Quad Core Intel® Xeon® processor.
 - 2) 8 GB Ram.
 - 3) 250 GB hard drive (40 GB for application and database).
 - 4) Two 10/100/1000 Ethernet network interfaces - one for communication with lighting management hubs and one for communication with corporate intranet to allow access from system PCs and/or energy saving display terminals. Only one Ethernet Network Interface is required if all lighting management hubs and client PCs are on the same network.
 - 5) Monitor with 1280 x 1024 resolution.
 - 6) 4 USB 2.0 ports.

- 7) Dedicated Graphics Card with 256 MB of memory (only required if running client software from the server).
- e. Minimum Software Requirements:
 - 1) Licensed installation of US English 64-bit Microsoft® Windows® Server 2008 R2, Windows Server 2012 R1, or Windows Server 2012 R2.
 - 2) Microsoft® Internet Information Services (IIS) 7 or later.
 - 3) Microsoft® Internet Explorer 9 or later.
 - 4) Microsoft® .NET Framework 3.5.
 - 5) Microsoft® .NET Framework 4.5.

2.08 LIGHTING MANAGEMENT SYSTEM SOFTWARE

- A. Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single Manufacturer.
- B. Configuration Setup Software:
 1. Product: Lutron Q-Design.
 2. Suitable to make system programming and configuration changes using a Graphical Floor Plan view or a generic system layout.
 3. Windows-based, capable of running on either central server or a remote client over TCP/IP connection.
 4. Publish Graphical Floor Plan: Allows the user to publish new Graphical Floor Plan files, allowing users to monitor the status of lights, occupancy of areas, and daylighting status.
 5. Back-Up Project Database: Allows the user to back up the Project database that holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
 6. Publish Project Database: Allows the user to send a new Project database to the server and download the new configuration to the system. The Project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
 7. Allows Manufacturer (either remotely or with on-site service call) or end-user (with training) to:
 - a. Capture system design:
 - 1) Geographical layout.
 - 2) Load schedule zoning.
 - 3) Equipment schedule.
 - 4) Equipment assignment to lighting management hubs.
 - 5) Daylighting design.
 - b. Define the configuration for the following in each area:
 - 1) Lighting scenes.
 - 2) Control station devices.
 - 3) Interface and integration equipment.
 - 4) Occupancy/after hours.
 - 5) Partitioning.
 - 6) Daylighting.

- 7) Emergency lighting.
 - 8) Night lights.
 - c. Startup:
 - 1) Addressing.
 - 2) Daylighting.
 - 3) Provide customized conditional programming.
- C. Control and Monitor Software:
1. Product: Lutron Quantum Vue.
 2. General Requirements:
 - a. Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
 - b. Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
 - c. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
 - d. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
 - e. All functionality listed below must be available via a single application.
 3. System Navigation and Status Reporting:
 - a. Performed using Graphical Floor Plan view or a generic system layout.
 - b. Graphical Floor Plan View: Utilizes customized CAD Based Drawing of the building. Pan and zoom feature allows for easy navigation; dynamically adjusts the details presented based on zoom level.
 - c. Area, scene, and zone names can be changed in real time.
 - d. Adjustments can be made based on area type.
 4. Control of Lights:
 - a. Control and monitor individual lights from a Graphical Floor Plan (with Lutron Eco-System digital ballasts/drivers).
 - 1) Individual lights can be monitored for on/off status.
 - 2) Individual lights can be turned on/off or sent to a specific level.
 - 3) High end of individual lights can be tuned/trimmed.
 - b. Control and monitor zone/area lights.
 - 1) Area lights can be monitored for on/off status.
 - 2) All lights in an area can be turned on/off or sent to a specific level.
 - 3) For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
 - 4) Area lighting scenes can be renamed and modified in real-time, changing the levels that zones go to when a scene is activated.
 - 5) High and low end of area lighting can be tuned/trimmed.
 - c. Control and monitor area partition status from a Graphical Floor Plan.
 5. Occupancy:
 - a. Area occupancy can be monitored.

- b. Area occupancy can be disabled to override occupancy control or in case of occupancy sensor problems.
 - c. Area occupancy settings including level that lights turn on to when area is occupied, and level that lights turn off to when area is unoccupied can be changed in real-time.
 - d. Monitor energy savings due to occupancy down to an individual area.
6. Daylighting:
- a. Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.
 - b. Daylight calibration can be adjusted for each day lit area.
 - c. Daylight status can be monitored.
 - d. Monitor energy savings due to daylight harvesting down to an individual area.
7. Load Shedding; Lutron IntelliDemand: Allows the building manager to monitor whole building lighting power usage and apply a customized load shed reduction to selected areas, thereby reducing a building's power usage; load shedding triggered via Quantum Vue Software or BACnet.
8. Scheduling: Schedule time of day and astronomic time clock events to automate functions.
- a. Adjust or disable a single occurrence of a repeating scheduled event.
 - b. Easily monitor and adjust scheduled events using a weekly calendar view.
9. Reporting: Provide reporting capability that allows the building manager to gather real-time and historical information about the system as follows:
- a. Energy Reports: Show a comparison of cumulative energy used over a period of time for one or more areas.
 - b. Power Reports: Show power usage trend over a period of time for one or more areas.
 - c. Energy Density Report: Show energy usage in W/sq. ft.
 - d. Energy Savings by Strategy Report: Show energy savings for any area broken down by strategy (tuning, occupancy, daylighting, scheduled events, personal control, and load shedding).
 - e. Space Utilization/Occupancy Reports: Show historical occupancy over a period of time for one or more areas using a graphical floor plan, generic system layout, and/or graphs and charts.
 - f. Activity Report: Show what activity has taken place over a period of time for one or more areas. Activity includes occupant activities (e.g. wall controls being pressed), building manager operation (e.g. controlling/changing areas using the control and monitor tool), and device failures (e.g. keypads or ballasts that are not responding).
 - g. Lamp Failure Report: Shows which areas are currently reporting lamp failures.
 - h. Sensor Level Report: Shows the light level in footcandles of any photo sensor in the system.
 - i. Alert Activity Report: Capable of generating historical reports of all alert activity within the system.

10. Diagnostics: Allows the building manager to check on the status of all equipment in the lighting control system. Devices to be listed with a reporting status of OK, missing, or unknown.
11. Alerts and Alarms: Monitors the system for designated events/triggers and automatically generates alerts according to configured response criteria.
 - a. Capable of monitoring for the following events/triggers:
 - 1) A failed piece of equipment (e.g. ballast, control, sensor, etc.); alert cleared when equipment is replaced.
 - 2) A lamp outage (for compatible EcoSystem digital electronic dimming ballasts only); alert cleared when lamp is replaced.
 - 3) Low battery conditions in battery-operated sensors and controls; alert cleared when battery is replaced.
 - 4) Luminaires with lamp operating hours in excess of designated time.
 - 5) A load shed event; alert generated for beginning and end of trigger.
 - 6) Energy usage higher than designated threshold target.
 - 7) Potential light level condition discrepancies (daylight sensors not agreeing with expected lighting status).
 - 8) Potential sensor failures (Radio Window sensors that have not seen a change in light level).
 - b. View alerts on a customized Graphical Floor Plan.
 - c. Capable of generating alerts through visible changes in software or through email messages.
 - d. Capable of customizing the frequency of alerts and providing notifications immediately or through daily, weekly, or monthly summaries.
 - e. Capable of sending different alerts to different system users.
 - f. Capable of generating historical reports of all alert activity within the system.
12. Administration:
 - a. Users: Allows new user accounts to be created and existing user accounts to be edited.
 - 1) Supports Active Directory (LDAP) tying user accounts to network accounts.
 - b. Area and feature access can be restricted based on login credentials with assigned levels of access rights (Monitor, Control Only, Control and Edit, Admin) and customized access levels available.
13. Quick Controls: Create shortcuts to activate customized system-wide actions, such as updating lighting and/or shade levels.
14. Provides control/monitoring of partition status to automatically reconfigure how the space operates based on the partition's open/closed status.
15. Variables: Used for custom program of a system and/or to signal a third party system. Any change may cause a change in the behavior of the system.
 - a. View the current state of system variables across subsystems.
 - b. Update the current variable state across all subsystems.
16. Device Lock/Unlock: Allows the building manager to lock control station devices to prevent building occupants from activating their programming (button presses), until they are unlocked.

- a. Keypads can be locked to help ensure occupants cannot change light and shade levels in a public space during specific events or business hours.
 - b. Keypads can be unlocked after events/during afterhours to allow maintenance, cleaning, security, and others to perform their tasks without needing to contact a Building Manager.
- D. Contractor shall provide factory commissioning to support pre-functional and functional testing with CxA witnessing.

2.09 CONTROL STATIONS

- A. Provide control stations with configuration as indicated or as required to control the loads as indicated.
- B. Wired Control Stations:
 1. General Requirements:
 - a. Power: Class 2 (low voltage).
 - b. UL listed.
 - c. Provide faceplates with concealed mounting hardware.
 - d. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
 - e. Finish: As specified for wall controls in "Device Finishes" under DIGITAL NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.
 2. Multi-Scene Wired Control:
 - a. General Requirements:
 - 1) Allows control of any devices part of the lighting control system.
 - 2) Allows for easy reprogramming without replacing unit.
 - 3) Replacement of units does not require reprogramming.
 - 4) Communications: Utilize RS485 wiring for low-voltage communications link.
 - 5) Engrave keypads with button, zone, and scene descriptions as indicated on the Drawings.
 - 6) Software Configuration:
 - a) Customizable control station device button functionality:
 - Buttons can be programmed to perform single defined action.
 - Buttons can be programmed to perform defined action on press and defined action on release.
 - Buttons can be programmed using conditional logic off of a state variable such as time of day or partition status.
 - Buttons can be programmed to perform automatic sequence of defined actions.
 - Capable of deactivating select keypads to prevent accidental changes to light levels.
 - Buttons can be programmed for raise/lower of defined loads.
 - Buttons can be programmed to toggle defined set of loads on/off.
 - 7) Status LEDs:
 - a) Upon button press, LEDs to immediately illuminate.

- b) LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or LEDs to turn off if the button press was not processed.
 - c) Support logic that defines when LED is illuminated:
 - Scene logic (logic is true when all zones are at defined levels).
 - Room logic (logic is true when at least one zone is on).
 - Pathway logic (logic is true when at least one zone is on).
 - Last scene (logic is true when spaces are in defined scenes).
- b. Wired Keypads; Lutron see Touch QS Wall stations:
- 1) Style: Architectural Non-Insert Style.
 - 2) Mounting: Wall-box or low-voltage mounting bracket; provide wall plates with concealed mounting hardware.
 - 3) Button/Engraving Backlighting:
 - a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
 - b) Backlight intensity adjustable via programming software.
 - 4) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
 - 5) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
 - 6) Terminal block inputs to be over-voltage and mis-wire-protected against reversals and shorts.
- c. Wired Keypads; Lutron QS Wired Palladiom Wall stations:
- 1) Style: Architectural Style.
 - 2) Mounting: Wallbox; provide wall plates with concealed mounting hardware.
 - 3) Buttons and Faceplate:
 - a) Buttons to be greater than 0.65 inch (16.5 mm) in height to provide large target area for ease of use and actuation.
 - b) Front of buttons to be flush with faceplate.
 - c) Buttons and faceplate to be of the same material and finish (e.g. plastic/plastic, glass/glass, metal/metal).
 - d) Buttons to depress and provide tactile feedback of a successful button push. Controls utilizing capacitive or resistive touch technology are not acceptable.
 - e) Gaps to be less than 0.007 inch (0.18 mm) between buttons and less than 0.15 inch (3.8 mm) between buttons and faceplate.
 - 4) Button/Engraving Backlighting:
 - a) Backlighting to be visible through engraved text to provide clear readability in a variety of lighting conditions.
 - b) Indicate active scene through the intensity of the backlighting (brighter backlit text indicates the active state).
 - c) Backlight intensity adjustable via programming software; capable of dynamic adjustment during usage based on conditional logic (time of day, button press, etc.).

- d) Backlight intensity automatically adjusts based on room ambient light level.
 - 5) Keypads to allow field-customization of button color and engraving using field-changeable replacement kits.
 - 6) Terminal block inputs to be over-voltage and mis-wire-protected against reversals and shorts.
- C. Wireless (Radio Frequency) Controls:
 - 1. Product(s):
 - a. Four-Button; Lutron Pico Wireless Control Model PJ2-4B.
 - 1) Button Marking: Scene keypads (light).
 - 2. Quantity: As indicated on the Drawings.
 - 3. Communicates via radio frequency to compatible dimmers, switches, and plug-in modules.
 - 4. Does not require external power packs, power or communication wiring.
 - 5. Allows for easy reprogramming without replacing unit.
 - 6. Button Programming:
 - a. Single action.
 - b. Toggle action.
 - c. Defined action on press and defined action on release.
 - 7. Includes LED to indicate button press or programming mode status.
 - 8. Mounting:
 - a. Capable of being mounted with a table stand or directly to a wall under a faceplate.
 - b. Faceplates: Provide concealed mounting hardware.
 - 9. Power: Battery-operated with minimum 10-year battery life.
 - 10. Finish: As specified for wall controls in "Device Finishes" under DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.

2.10 LOW-VOLTAGE CONTROL INTERFACES

- A. Provide low-voltage control interfaces as indicated or as required to control the loads as indicated.
- B. UL listed.
- C. Sensor Modules:
 - 1. Products:
 - a. Sensor module with both wired and wireless inputs; Lutron Model QSM2-4W-C.
 - 2. Wired Modules:
 - a. Provide wired inputs for:
 - 1) Occupancy sensors.
 - 2) Daylight sensors.
 - 3) IR receivers for personal control.
 - 4) Digital ballast wall stations.
 - 3. Wireless Modules:

- a. Provide wireless communication inputs for:
 - 1) Occupancy sensors.
 - 2) Daylight sensors.
 - 3) Wireless controller.
 - b. RF Range: 30 feet (9 m) between sensor and compatible RF receiving devices.
 - c. RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
4. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

2.11 WIRED SENSORS

A. Wired Occupancy Sensors:

- 1. General Requirements:
 - a. Connects directly to compatible ballasts and modules without the need of a power pack or other interface.
 - b. Turns off or reduces lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space.
 - c. Accommodates all conditions of space utilization and all irregular work hours and habits.
 - d. Comply with UL 94.
 - e. Self-Adaptive Sensors: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space; furnished with field-adjustable controls for time delay and sensitivity to override any adaptive features.
 - f. Provide capability to:
 - 1) Add additional timeout system-wide without need to make local adjustment on sensor.
 - 2) Group multiple sensors.
 - g. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.
 - h. Furnished with all necessary mounting hardware and instructions.
 - i. Class 2 devices.
 - j. Color: White.
- 2. Wired Dual Technology Sensors:
 - a. Passive Infrared: Utilize multiple segmented lenses, with internal grooves to eliminate dust and residue build-up.
 - b. Ultrasonic: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005% tolerance.

2.12 WIRELESS SENSORS

A. General Requirements:

- 1. Operational life of 10 years without the need to replace batteries when installed per Manufacturer's instructions.

2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
 3. Does not require external power packs, power wiring, or communication wiring.
 4. Capable of being placed in test mode to verify correct operation from the face of the unit.
 5. RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).
 6. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC Requirements of CFR, Title 47, Part 15, for Class B application.
- B. Wireless Occupancy/Vacancy Sensors:
1. General Requirements:
 - a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
 - b. Utilize multiple segmented lenses, with internal grooves to eliminate dust and residue build-up.
 - c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
 - d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
 - e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
 - f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1% to 100%.
 - g. Color: White.
 - h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
 - i. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
 - j. Sensor lens to illuminate during test mode when motion is detected to allow Installer to verify coverage prior to permanent mounting.
 - k. Ceiling-Mounted Sensors:
 - 1) Provide customizable mask to block off unwanted viewing areas.
 2. Wireless Combination Occupancy/Vacancy Sensors:
 - a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).
- C. Wireless Daylight Sensors:

1. Product: Lutron Model LFR2-DCRB.
2. Open-loop basis for daylight sensor control scheme.
3. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
5. Provide linear response from 0 to 10,000 footcandles.
6. Color: White.
7. Mounting:
 - a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
 - b. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
 - c. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
8. Meets California Title 24 Requirements.

2.13 ACCESSORIES

- A. Emergency Lighting Interface:
 1. Product: Lutron Model LUT-ELI.
 2. Provides total system listing to UL 924 when used with lighting control system.
 3. Senses all three phases of building power.
 4. Provides an output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to an emergency light level setting. Lights to return to their previous intensities when normal power is restored.
 5. Accepts a contact closure input from a fire alarm control panel.
- B. Provide power supplies as indicated or as required to power system devices and accessories.

2.14 SOURCE QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control for Additional Requirements.
- B. Factory Testing; Lutron Standard Factory Testing:
 1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
 2. Perform full-function factory testing on 100% of all ballasts and LED drivers.
 3. Perform factory audit burn-in of all dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for 2-hours.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those Standards.
- B. Install products in accordance with Manufacturer's instructions.
- C. Provide dedicated network between lighting management system computer and lighting management hubs.
- D. Define each dimmer/relay load type, assign each load to a zone, and set control functions.
- E. Sensor Locations:
 - 1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with Drawings.
- F. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.
- G. Lamp Burn-In: Operate lamps at full output for prescribed period per Manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- H. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).
- I. System and Network Integration Consultation; Lutron LSC-INT-VISIT: Include as part of the base bid additional costs for Lighting Control Manufacturer to conduct meeting with Facility Representative and other related Equipment Manufacturers to discuss equipment and integration procedures.
 - 1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Control for Additional Requirements.
- B. Manufacturer's Startup Services; Lutron Standard Startup Services:
 - 1. Manufacturer's Authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
 - 2. Conduct Pre-Installation visit to review Requirements with installer as specified in Part 1 under "Administrative Requirements".
 - 3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
 - a. Verify connection of power wiring and load circuits.
 - b. Verify connection and location of controls.
 - c. Energize lighting management hubs and download system data program.
 - d. Address devices.
 - e. Verify proper connection of panel links (low voltage/data) and address panel.

- f. Download system panel data to dimming/switching panels.
 - g. Verify system operation control by control.
 - h. Verify proper operation of Manufacturer's interfacing equipment.
 - i. Verify proper operation of Manufacturer's supplied PC and installed programs.
 - j. Configure initial groupings of ballast for wall controls, daylight sensors and occupancy sensors.
 - k. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
 - l. Train Owner's Representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
 - m. Obtain sign-off on system functions.
4. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.03 COMMISSIONING

- A. See Section 01 81 00 - Commissioning for Commissioning Requirements.
- B. Title 24 Acceptance Testing Service; Lutron LSC-SPV-DOC-T24: Include as part of the base bid additional costs for Lighting Control Manufacturer to perform lighting control acceptance testing in accordance with CAL TITLE 24 P6. Submit required documentation.

3.04 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Procedures for Closeout Submittals.
- B. Demonstration:
 - 1. On-Site Performance-Verification Walkthrough; Lutron LSC-WALK: Include as part of the base bid additional costs for Lighting Control Manufacturer to provide on-site demonstration of system functionality to Commissioning Agent.
- C. Training:
 - 1. Include services of Manufacturer's Authorized Service Representative to perform on-site training of Owner's Personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.
 - a. Include training on software to be provided:
 - 1) Configuration software used to make system programming and configuration changes.
 - 2) Control and monitor.

3.05 MAINTENANCE

- A. See Section 01 78 50 - Operating and Maintenance Data for Additional Requirements relating to maintenance service.
- B. Software Maintenance Agreement; Lutron LSC-SMA: Include as part of the base bid additional costs for Manufacturer to provide quarterly compatibility testing results for PC-based lighting control software and new patches issued for Microsoft Operating System, Database, and Browser tools.

1. If new Microsoft patches create a software conflict, Manufacturer to provide lighting control software patches to ensure continued operation.
- C. System Optimization Visit; Lutron LSC-SYSOPT: Include as part of the base bid additional costs for Lighting Control System Manufacturer to visit site 6-months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

END OF SECTION 26 09 43
090319/212220-SSB

SECTION 26 10 05
POWER DISTRIBUTION (OVER 600 VOLTS)

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.
- B. Additional Requirements for Conductors and Raceways of Circuits Greater than 600 volts.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit Product Data Sheets for all Wire, Conduit, Fittings, Splicing, and Terminating Materials.
- B. Submit Material List for all Conduit and Fittings.
- C. Perform Factory High Voltage AC and DC and Corona Level Conductor Tests per ICEA Standards on each length of cable. Submit Certified Reports of Factory Tests, together with all data necessary to determine that cable is as specified, including type of conductor, AWG size and stranding; type and thickness of insulation and jacket; type of shielding; insulation resistance constant corrected to standard temperature; voltage rating. Use standard ICEA terminology in reports.
- D. Submit the AEIC Qualification Test Reports Data.

1.03 FACTORY TESTING

- A. Final Testing on Shipping Reel
Each completed length of conductor shall be subjected to a 1-minute AC test voltage prior to shipping after the conductor's have been placed on the shipping reels. AC test voltage shall be 25kV for 5/8kV insulated conductors and 34kV for 15kV insulated conductors.
- B. Conductors, which fail the specified Factory Tests, are unacceptable and shall not be used. Submit eight copies of Factory Test Reports for review. Conductors shall not be installed until the Architect has reviewed the Factory Test Reports.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. General
 - 1. Cables conductor sizes and quantity as indicated on Drawings.
 - 2. Cable shall be in compliance with the latest applicable Requirements of UL, OSHA, NEMA, NEC, ASTM, AEIC and ICEA for installations indicated.

3. All cable must have been manufactured within 1-year of award of Contract. As manufactured by Okonite "Okoguard-Okoseal"; or Prysmian Cable Systems; or Kerite Company.
 4. The following minimum information shall be factory imprinted on the cable jacket, a minimum of 36-inches on center.
 - a. Manufacturers name.
 - b. Insulation type and voltage level.
 - c. Date of manufacture.
 - d. Conductor size and material.
 - e. Jacket type.
 5. Cable shall be shipped and stored on cable reels and cable ends shall be sealed water-tight at all times. Cables not so shipped, stored and sealed shall be rejected.
 6. The cable shall be rated 105 degrees C for normal operation, 140 degrees C for emergency overload operation, and 250 degrees C for short circuit conditions.
 7. UL listed as type MV-105 per UL-1072.
 8. Jacket shall be oil resistant, complying with "Oil Resistant-1" and "Oil Resistant-2" UL 1072.
- B. Power Cable Construction (Phase to Phase System Operating, Voltage, 2000 volt thru 5000 volt.)
1. Conductor – single conductor copper, Compact Stranded per ASTM B496, ICEA S-68-524, NEMA WC-8 and UL-1072.
 2. Conductor Strand Screen – continuous extruded layer over the conductor per ICEA S-68-516, AEIC CS-6, NEMA WC-8, and UL-1072.
 3. Insulation – continuous Ethylene Propylene Rubber (EPR). 115 mil for 8 KV 100% insulation level, 5KV 133% insulation levels. Extruded over and bonded to conductor strand screen meeting or exceeding ICEA S-68-516, NEMA WC-8, AEIC CS-6, and UL 1072.
 4. Insulating Screen – continuous, extruded, semi-conducting screen over the insulation meeting or exceeding ICEA S-68-516, AEIC CS-6 and UL-1072.
 5. Shield – 5-mil copper tape shield applied with not less than a 12.5% overlap and full 100% coverage over insulation screen. Per UL-1072, ICEA S-68-516, and NEMA WC-8 (shield shall be omitted on cable utilized as a neutral conductor).
 6. Jacket – non-metallic black sunlight resistant PVC (polyvinylchloride) extruded over shield, per ICEA S-68-516, NEMA WC-8, and UL-1072.
- C. Power Cables Construction (Phase to Phase System Operating Voltage 5001 volt thru 13000 volt).
1. Conductor - single conductor copper, Compact Stranded per ASTM B496, ICEA S-68-524, NEMA WC-8, and UL-1072.
 2. Conductor strand screen - continuous extruded layer over conductor per ICEA S-68-516, AEIC CS-6, NEMA WC-8, and UL-1072.
 3. Insulation - continuous Ethylene Propylene Rubber (EPR). 220 MIL for 15KV, 133% insulation levels. Extruded over and bonded to conductor strand-screen meeting or exceeding ICEA S-68-516, NEMA WC-8 AEIC CS-6, and UL- 1072.

4. Insulating screen - continuous, extruded, semi-conducting screen over the insulation meeting or exceeding ICEA S-68-516, AEIC CS-6, and UL- 1072.
5. Shield - 5-mil copper tape shield applied with not less than a minimum of 12.5% overlap and 100% coverage over insulation screen. Per UL 1072, ICEA S-68-516, NEMA WC-8.
6. Jacket - non-metallic black sunlight resistant PVC (polyvinylchloride) extruded over shield, per ICEA S-68-516, NEMA WC-8, and UL- 1072.

2.02 CONDUCTOR SPLICING AND TERMINATIONS

A. General

1. All material used shall be compatible with specific cable installed and shall be rated for 90 degrees centigrade normal operation, 130 degrees centigrade emergency overload operation, and 250 degrees centigrade for short circuit conditions.
2. Shall be in compliance with Manufacturer's standard recommendations. Splices shall be suitable for continuous immersion in water.
3. Splices and terminations shall meet Class-1 Requirements.
4. The splices and terminations shall match and be compatible with the respective cable type, insulation, shielding and jacket.
5. Ground cable shield at each splice and termination.

B. Splices - (Built-Up Tape Type, for Pvc Jacket Cables)

1. General

- a. Conductors shall be joined by "T" type, "Y"-type or inline (as applicable) compression, tinned copper sleeves connectors, installed with hydraulic "die" compression tool. Sleeves shall have chamfered ends, and cable stops to properly center on conductor. Ampacity equal to conductor. 3M- "Scotchlok", Burndy-"144 splice".

2. Built-up tape type for pvc jacket cables

- a. Individual splices shall be hand laid built-up self-vulcanizing, insulating tape, with stress relief. Splice kits as manufacturing by Kerite, 3M or Plymouth.

3. Polymeric cable splices kits:

- a. Heat shrink or mechanical preshrink (cold shrink) uniform cross section, with linear stress relief and dielectric insulating layers; metallic shielding across splice with ground lead out; overall jacket sleeve.
- b. Comply with IEEE 48 and 404; seal environmental to provide ANSI C119.2 water immersion test, latest revisions.
- c. Outdoor weather tight construction, anti-tracking ultraviolet solar radiation overall jacket protection. As manufactured by Raychem or 3M.

C. Terminations (Indoor built-up tape type, or polymeric termination kit for PVC jacket cables where cable terminator is not specified with equipment).

1. General

- a. Conductor shall be terminated with compression tinned copper seamless, barrel terminal lugs installed with hydraulic "die" compression tool. Terminal lug shall be

4-bolt spade lug type for bus connections or stud type for other locations. Burndy- "Hylug" or 3M- "Scotchlok".

2. Individual cable terminations shall be hand laid, built-up self-vulcanizing insulating tape with stress relief. Termination kits as manufactured by Kerite, 3M or Plymouth.
3. Polymeric cable termination kits:
 - a. The incoming line feeders shall be provided with premolded insulated primary conductor termination kits. The termination kits shall conform properly to compatible with the conductors shown on the Drawings, including out of round cables as defined on AEIC and ICEA heat shrink or mechanical preshrink. The termination shall environmentally seal the cable jacket. Stress relief and feeder insulation shield grounding. Provide anti-tracking skirts on terminations.
 - b. Provide 4-bolt copper spade lug cable connector compression connectors, and bolt each termination to respective phase lug landings. Grade 5 Hex head bolts and Belleville washers. As manufactured by 3M or Raychem.
4. Terminations shall comply with IEEE-48- (latest revision) Class 1 conductor terminations shall all be 15kV Class:
 - a. AC withstand input (kV) 50
 - b. DC withstands, 15-minute (kV) 75
 - c. Partial discharge, minimum kV for 3pC or less 15.6
 - d. BIL basic impulse withstand 1.2 x 50 micro seconds crest kV (outdoor) 110
 - e. BIL basic impulse withstand 1.2 x 50 micro seconds crest
kV (indoor) 95
 - f. Continuous current rating (normal, overload,
emergency)equal to connected cable
 - g. Nominal overall length (inch) 15.5
 - h. Wet withstand, 10 seconds (kV rms) 45
 - i. Dry withstand, 6 hours (kV rms) 35
 - j. To match connected cable and type.
5. Provide a minimum of two conductor cable landings for each incoming line phase termination.
6. Provide removable, electrically insulated, "boots" to completely cover each termination connection bolted lug landing and bus connection.
7. Primary cable supports shall be provided to eliminate any strain on cable terminations.

2.03 SEPARABLE INSULATED CONNECTOR, ELBOW CABLE TERMINATORS AND APPARATUS BUSHING WELLS

A. General

1. Separable insulated connector system cable terminators shall be non-load break, molded thermoplastic and molded rubber 200 amp for wire sizes smaller than 4/0 AWG, 600 amp for wire sizes 4/0 AWG and larger, unless noted otherwise on Drawings.
 - a. De-energized dead-break bolted connects, unless noted otherwise on Drawings.
2. Assemblies shall be rated for continuous submersion in 10 feet of water.

3. Provide terminators to accommodate the connecting feeder cable type and size.
4. Insulated, shielded, dead front, safety plug, one for each cable phase, complying with ANSI C119 and 386 latest revisions. Shall be designed, manufactured, and tested to comply with IEEE-386 and IEEE-592 latest revisions. Suitable for “insulated-hook-stick” insertion and removal.
5. Elbows and apparatus bushing wells shall be mechanically and electrically compatible. Shall be inter-changeable operation between multiple Manufacturers.
6. Provide “parking” stands for each termination and phase, in each location.
7. As manufactured by G & W Electric; or Elastimold/Thomas & Betts.

B. Electrical Ratings

	System Voltage Electrical Ratings	System Voltage 2400V or 4160V	above 4160 volt to 13000 volt
1.	Line to ground rating	8.3kV	15.2kV-RMS
2.	Impulse withstands voltage BIL.	95kV-RMS	125kV
3.	Withstand voltage, 60Hz AC	34kV-RMS	40kV-RMS
4.	Withstand voltage D.C. 15 minute	53kV D.C.	78kV D.C.
5.	Corona Extinction	11kV D.C.	19kV D.C.
6.	200 amp elbow - momentary withstand for 10Hz	10,000AMP-Sym.	10,000AMP-SYM
7.	600 amp elbow – momentary withstand for 10Hz	18,000 Sym.	18,000 Sym.
8.	Continuous load current	200AMP-RMS (600 AMP-RMS)	200AMP-RMS (600 AMP-RMS)

C. Elbow Connector Test Point

1. Each elbow shall be provided with front accessible capacitive coupled test point.
2. The test point shall include a protective, removable, voltage insulated, snap-in cap to provide test point access.

D. Fault Indicator

1. Provide a fully automatic, capacitance coupled electrical, visual fault indicator installed in each test point.
2. Self-powered through capacitive coupling when installed in the elbow test point.
3. The fault current indicator pick-up current and operating speed shall be selected based on upstream relay/fuse types and settings, for correct fault indicates. Additionally, it shall prevent false fault-indication caused by normal motor, transformer and conductor charging in rush (turn-on) currents.

E. Multi-Point-Junctions

1. Shall distribute primary voltage multiple circuit taps for separable elbow-connectors. Modular, premolded, insulated, with internal 600 ampere single phase copper distribution bus.

2. Provide quantity of multiport connector ports on each junction for multiple insulated separable elbow connector attachments, plus spares. Electrical characteristics and insulation characteristics shall match the elbow connectors.
3. Fully shielded and fully insulated and fully submersible in water when energized.
4. 304 – stainless steel surface mounting brackets with ground lug. Provide two integral (left-right) “parking” stands for elbow connectors.
5. Provide bushing inserts for electrical and mechanical compatibility with respective elbow connectors.
6. Provide not less than three multi-point-junction assemblies at each location; Phase-A, Phase-B, and Phase-C. Provide not less than two additional spare connection ports on each multi-point-junction assembly for future use.
7. Interface spacing between ports shall be uniform and compatible with respective elbow connectors.

2.04 CONDUIT (ADDITIONAL REQUIREMENTS)

- A. Aluminum Conduit, Flexible Metal or Non-metal Conduit and Electrical Metallic Tubing shall not be used.
- B. Rigid Galvanized Steel Conduit shall be used for all exposed and concealed conduit above grade and for bends and risers below grade.
- C. Nonmetallic Conduits Schedule 40 PVC or type "EB" shall be used for all ducts below grade, and shall be completely concrete encased in a 3-inch concrete envelope the entire length, including below building slabs.
- D. Bury Underground Conduit a minimum of 36 inches to top of concrete encasement below final finish grade, including under building slabs.
- E. Provide End Bells on All Conduit Terminations.
- F. Condulets shall not be used.
- G. Provide Molded, Snap Together, Conduit Support Spacers a minimum of 5-feet on center in all underground multiple conduit installations.

The spacing between conduits located below grade shall be as follows:

1. Two inches between conduits for circuits operating above 600 volts.
2. Six inches between conduits for circuits operating above 600 volts and conduits for circuit operating below 600 volts.
3. Twelve inches from conduits for any Utility Company circuits and pipes.

2.05 FIREPROOFING

- A. The Cable Fireproofing shall consist of a hand applied flexible tape, conformable fabric coated with flame retardant and separate securing tape wrap. As manufactured by 3M or Plymouth.
- B. The Tape shall be a flexible polymeric coating and/or chlorinated elastomer not less than 0.03 inch thick, weighing not less than 2.5 pounds per square yard.
- C. The Tape shall be non-corrosive to the cable jacket.
- D. The Tape shall be self-extinguishing shall not support combustion, and shall withstand high current fault ARC temperatures of 13000 degrees Kelvin for 70Hz.

- E. The Tape shall not deteriorate when subjected to oil, water, salt water, sewage and fungus.

PART 3 - EXECUTION

3.01 CONDUCTORS IN RACEWAYS

A. Conduit Preparation

1. Metallic conduit shall be reamed and cleaned to remove metal cuttings, fillings and cutting oil.
2. Rod all underground raceways, including existing raceways to be used under this Contract, with approved test and flexible mandrels to remove all obstructions. Use test mandrels at least 12-inches long, ¼-inch less than diameter of duct at center, tapering to ½-inch less than duct size at ends. Do all cleaning and testing in the presence of Owner's Representative.
3. If test mandrels cannot be pulled through Raceways Contractor shall perform the following to clear the raceways.
 - a. Force rigid or semi-rigid rods through the raceways to clear the obstructions from one or both ends of the raceway.
 - b. Force a power driven rotating router device with small diameter cutting blades, in incremental stages to a cutting blade diameter approximately ⅛-inch smaller than the raceway inside diameter.
After clearing the raceway of obstructions pull a test mandrel or brush through the raceway to clear the remaining debris from the raceway.

B. Cable Lubrication:

1. Cable pulling lubricants shall be specifically approved by the Cable Manufacturer. The following lubricants shall be used where approved by the Cable Manufacturer.
 - a. Slip X -300, American Colliod Co.
 - b. Bishop #45, Bishop Electric.
 - c. MacLube CA51, MacProducts.
 - d. Minerallac H2B,- Minerallac Electric.
 - e. Winter grade #7437-PC, General Machine Products.
 - f. Gel-lube 7/5, Cable associates.
 - g. Polywater, A, C, G - American Polywater.
2. Lubricants shall be continuously applied as cable enters raceway.

C. Pulling Tensions "EPR" Insulation PVC Jacket, Copper Conductors.

1. The maximum pulling-in tensions and stresses on the cable must not exceed the under-mentioned values when pulling the cable.
 - a. The maximum pulling stress in pounds (tension), shall not exceed 0.008 times the CM (Circular Mil) area of the conductor when pulled with a pulling eye attached directly to each copper conductors, (i.e. $(500,000 \text{ MCM}) \times (.008) = 4000 \text{ pounds}$).
 - b. The maximum pulling stress shall not exceed 1000 pounds for non-leaded cables when pulled with a Kellums or Greenlee type basket grip on each conductor but in any case shall not exceed item (a) above.

- c. The cable sidewall pressure shall be defined as the pulling tension on the cable out of a bend, expressed in pounds divided by the radius of bend expressed in feet. The maximum cable side wall pressure (pulling tension) in pounds shall not exceed 400 times the raceway bend radius in feet. But in any case shall not exceed 'a' and 'b' above (i.e. (4 feet conduit radius) x (400) = 1600 pounds maximum pulling tension at the 4 feet conduit bend).
 - d. Pulling tension calculations shall be submitted to Engineer prior to pulling any cable, for each cable run in excess of 100 feet and/or 180 degrees in bends. Similar runs need not be recalculated (i.e. same quantity and type of bends and/or length).
- 2. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200 feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.
- 3. Pulling eyes on each conductor shall be used for cable runs in excess of 100 feet or more than 180 degrees in bends, between pull points.
- D. The Minimum Radii to which the installed cables can be bent for safe electrical operation and without danger of physical damage to the cable insulation, metallic shielding tapes, and/or outer jacketing materials shall not be less than 12 times the diameter over the finished cable jacket. Bends shall not be made in splices or terminations.
- E. Installation
 - 1. Do not pull conductors until factory test reports have been submitted and reviewed.
 - 2. The attachment of the pulling device to the conductor pulling eyes or basket grips shall be made through a swivel connector.
 - 3. The attachment of pulling devices directly to the cables shall be with individual basket grips over each cable jacket or individual pulling eyes attached directly to each cable conductor. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.
 - 4. The Contractor shall ensure that the high voltage cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".
 - 5. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway. Lead-out the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next run. Cables shall not be pulled directly around a short right angle bend.
 - 6. For each cable pull where a cable direction change is required flexible feed-in tubes, pull-out devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable-bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable sidewall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.
 - 7. Cable lengths over 50 feet shall be machine pulled not hand pulled. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.

8. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pullhole during this operation. Cables shall be pulled directly from cable reels.
 9. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts conduits or cables. To prevent damage from falling objects or Personnel entering the manhole the cables shall not pass directly under the manhole opening.
 10. Cable shall be supported in manholes; pull boxes and vaults a minimum of 18-inches on center with cable racks. Provide hot dip galvanized T-slot racks and support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more than one feeder on the same rack hook.
 11. Cables shall be routed the long way around manhole, pullhole, etc. unless noted otherwise.
 12. Existing conductors shall be protected at all times when Contract Work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.
- F. Movement, Storage, and Handling of Cable
1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.
 2. Lift and move cable reels using following methods:
 - a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
 - b. Forklift type of equipment may be used to move smaller, narrower width reels. Fork times should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
 - c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear or debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.
 3. Storage of Reels of Cable
 - a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2-inches down to insulation. Then apply four layers of an insulating tape criss-cross over the cable

end and carry back at least 4-inches onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.

- b. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
- c. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
- d. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

G. Cable Testing

1. Contractor shall have an independent Testing Laboratory perform a high voltage DC acceptance test on each phase or leg of cables in accordance with ICEA Standards S-19-81, latest revision. Certified Test Reports shall be submitted to Engineer in the form of time versus current graph showing initial leakage current after test voltage is applied and for each 15 second interval up to 1-minute and for each one minute interval thereafter. Each graph shall be identified to correspond with the Cable Section and feeder name. Information on temperature, humidity and type of test equipment used during test shall also be submitted.
2. Cables shall be tested as follows:
 - a. Each segment and phase shall be tested after installation and prior to splicing or terminating to other equipment or cables.
 - b. Each conductor feeder and phase shall be tested after splicing to other new cables is completed, and prior to connection to equipment or other existing cables.
 - c. Do not perform D.C. high voltage cable acceptance test into existing conductors, new or existing equipment, connected to the cables being tested.
3. Certified Factory Test Reports performed in accordance with ICEA S-19-81, Tables 2-12 and 6-17. Corona and AC/DC Tests shall be submitted with Shop Drawings for the specific cable to be installed.
4. Field test procedure:
 - a. Set up test equipment. Do not connect test lead to cables, but temporarily hang the lead free with a plastic bag over the clip. Raise the voltage to the same final level as the cables test voltage. The leakage current seen on the DC meter is leakage in the test lead, and shall be subtracted from the readings taken later during the cable test. Shut the set off and discharge the lead.
 - b. Apply the test voltage to each phase separately, making sure that all other phases, all cable shields, any armoring or neutral conductors, and other nearby metallic objects are grounded to prevent voltage pick-up.
 - c. Raise the test voltage from zero gradually in 10% steps to 80% of the final test voltage, then in 5% steps to final test voltage, which shall be left on for 5 minutes. Take current readings at each step after current has been stabilized approximately 1-minute intervals. Take current reading each minute period. Record each step voltage/current and time interval. Plot readings on graph paper.
 - d. During the test if a breakdown is indicated by a sudden or continuous increase in current, de-energize, disconnect and isolate the trouble. Remedy problem,

completely disassemble and redo any defective cable terminations or splices. Retest cable, if breakdown is again indicated, remove, discard and replace defective cable and retest replacement cable. Defective cable shall be removed from site and shall not be reused.

- e. Upon completion of a successful test, shut down the test set and allow the voltage to decay to $\frac{1}{4}$ the full value. Record the decay time.
- f. Solidly ground the conductor and allow the ground to remain in place for a period at least as long as the test time.
- g. Repeat the same test sequence for each phase cable and cable section.
- h. Proper precautions shall be taken to eliminate "end corona" during the test procedure. The leakage currents and the voltage decay times should be fairly similar for the individual phases of the same cable circuit. Also, a graphic plot of the current versus voltage values of the step-rise test should show a reasonably straight line (equal increments of current rise for equal increments of voltage increases), the current readings always being taken after the same duration of time (one minute) after reaching each voltage level. To insure proper testing procedures the Contractor shall do the following:
 - 1) The cable ends (or terminations) are clean and dry.
 - 2) The cable or terminal ends are as far away from surrounding structures as practical.
 - 3) The creep-age distance from conductor back to cable shield is at least 1-inch for each 5kV of test voltage (this applies to newly installed cable, which has not yet been terminated).
 - 4) The irregularly shaped clip or connector where the test lead joins to the cable is wrapped with a few layers of plastic sheet to form a smooth tube to reduce corona.
 - 5) The free ends of cable have a glass jar or plastic bag over the end to reduce corona.
- i. The final D.C. test voltages for shielded cable shall be 30kV for 5kV or 8kV cable and 56kV for 15kV cable.

3.02 ARC PROOFING (FIREPROOFING)

- A. All Wires and Cables which will carry current at 600 volts or more in manholes, pullboxes, and vaults shall be fireproofed.
- B. Strips of Fire Proofing Tape approximately $\frac{1}{16}$ inch thick by 3-inches wide shall be wrapped tightly around cable spirally in wrapping. The tape shall be applied with the coated side toward the cable and shall extend one inch into the ducts. To prevent unraveling, the fire-proofing tape shall be spirally "Half-Lap" wrapped the entire length of the cable.
- C. Fire Proofing shall be applied separately on each individual conductor. Secure fire proofing with two layers of spirally wrapped glass cloth electrical tape.

3.03 CABLE SPLICES AND TERMINATIONS

- A. Cable Splicing and Terminations shall be performed by Personnel with a minimum of 5 years-qualified experience with specific splicing and termination methods used. Submit letter-certifying qualifications.

- B. Each Conductor shall be spliced in each manhole and pullbox whether or not shown on the Drawings. No splices or terminations will be allowed in conduit or ducts.
- C. Cable Shield shall be brought out and grounded at each splice and termination point to the equipment bond grounding system.
- D. Splices (Built-Up Tape Type for PVC Jacket Cables)
 - 1. Cables shall be striped, tapered rasped with creep-age distances per Manufacturer recommendations. Apply fill sealing putty on conductor compression sleeve indents and conductor, prior to beginning of splice taping.
 - 2. Conductor compression connectors shall be crimped with tools and specifically designed for the connector.
 - 3. Apply tape over conductor and connector sleeve.
 - 4. Apply splicing cement to rasped insulation and insulation screen.
 - 5. Apply insulating tape.
 - 6. Apply friction tape over insulation tape.
 - 7. Apply conducting fabric tape.
 - 8. Apply open spiral of tinned copper wire braid to carry shield continuity across the splice. Tack solders to 5-mil copper shield tape on each side of splice an additional single ground braid. Ground braid shall be brought out at splice, minimum 18-inches long and connected to ground bonding conductor, bind down braid with friction tape.
- E. Terminations (indoor built-up) Tape Type, for PVC Jacket Cables where cable terminator is not specified with equipment).
 - 1. Cables shall be striped tapered, rasped with creep-age distances per Manufacturer recommendations.
 - 2. Conductor compression connectors shall be crimped with tools and dies specifically designed for the connector.
 - 3. Tack solder to 5 mil copper shield tape, tinned copper shield tape, Bind down with friction tape. Bring out approximately 18-inches of ground braid and connect to ground bonding conductor.
 - 4. Apply sealing putty at tape shield/insulation joint and connector lug indents.
 - 5. Apply insulating tape.
 - 6. Apply friction and electrical tape.
 - 7. Make lug seal applying insulating tape, friction tape and electrical tape.
 - 8. Apply friction and electrical tape.
- F. Polymeric Cable Splice Kits and Termination Kits
 - 1. Install in strict compliance with the Manufacturer instructions.

3.04 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. Each Cable and Cable Tap shall be identified with nametags in manhole pullboxes, terminations and vaults.

- B. Identification Tags shall include the following information:
1. Feeder name as indicated on Drawings (i.e. HV1, F4, MSB3 etc.).
 2. Conductor phase (i.e. phase A, or phase B, or phase C, or neutral).
 3. Installation month and date (i.e. 3/85, 4/78 etc.).
 4. Conductor size conductor type (copper or aluminum) and insulation type (i.e. 4/0 CU-EPR, 500 AL VCL, etc.).
 5. Insulation voltage (i.e. 5kV, 8KV, 15kV, etc.).
 6. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, XMRA, etc.).
- C. Tags shall be 1/8-inch thick 98% lead, approximately 2-inches square with chamfered corners. Two holes shall be drilled for attachment to primary cable. Lettering shall be 1/8-inch high, engraved or die stamped. Attach tags to primary cables with two #14 AWG (THWN insulated) solid copper conductors "twist-tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.
- D. Alternate Identification Tags, at the Contractor's option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tags with black alpha-numeric characters sets. Characters shall be a minimum of 0.25-inch high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey, William Frick & Co. - Vernon Hills, ILL.
- E. Hot-Phasing
- The Contractor shall perform and certify phase rotation testing on connections to existing / new circuits and equipment. Testing shall verify equipment and conductors are correctly "Hot-Phase" sequenced, to allow interconnecting and inter switching of any "Hot" circuits of like voltage with correct phase sequencing. The Contractor shall correct any phasing sequence found to be incorrect as a result of work performed by this Contract.

3.05 GROUNDING ADDITIONAL REQUIREMENTS

- A. Raceways
1. Provide all raceways and conduits containing circuits operating at line to line or line to ground voltages exceeding 600 volts with an internal dedicated equipment ground/bond wire, copper conductors, 600 volt insulation.
 2. Typical for metallic and non-metallic raceways and conduits.
- B. Splices and Terminations
1. Provide cable shield ground/bond lead out at each conductor splice and termination location. Extend and connect to respective equipment ground bus; each pullbox/man-hole respective ground rods and feeder ground conductors; etc.

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SECTION 26 24 13 SWITCHBOARDS

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Provide Schematic "Ladder Type" logic control wiring diagrams and "point-to-point control wiring diagrams showing control and protective systems interlocks.
- B. Provide Nameplate Engraving Schedule.
- C. Submit Full-Scale Time/Current Transparencies on log/log paper for all fuses, circuit breakers, ground fault system devices, and relays. Additionally, provide software to generate time/current curves of each circuit protection device.
- D. Short Circuit, Coordination and Arc-Flash
 - 1. Perform and submit engineered settings for each equipment location, fuse and circuit breaker device, showing the correct time and current settings to provide the selective coordination within the limits of the specified equipment, per the latest applicable Standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the coordination analysis recommendations. Provide Electric Arc-Flash calculations as part of the coordination analysis recommendations.
 - 2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an engineering narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.
 - 3. The goal is to minimize an unexpected but necessary electrical system outage and Personnel exposure to the smallest extent possible within the fault occurrence location, using the specified contract equipment. Shall comply with, but not limited to:
 - a. IEEE-242, Recommended Practices for Protection and Coordination of Industrial and Commercial Distribution.
 - b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - c. IEEE-1584, Guide to Performing Arc-Flash Hazard Study.
 - d. CEC/NEC

4. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with “Electric-Arc-Flash” warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct Personnel to wear the correct protective equipment/clothing (PPE) when working “Live”, or operating “Live” electrical equipment and circuits.
- E. Factory Tests: Equipment tests - ANSI C37.20. Certified copies of design tests, production tests, and conformance tests of the equipment shall be submitted and review comments shall be received before delivery of equipment to the Project site. In lieu of the above tests, a report of these tests previously performed on identical units of each rating will be acceptable.

1.03 APPLICABLE STANDARDS

- A. The switchboard and switchgear equipment shall be designed, tested and assembled to comply with ANSI, IEEE, and NEMA and UL.
- B. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements).
 1. The complete switchboard/switchgear assembly; including circuit protection devices, meter, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
 - a. Wind loading all outdoor equipment locations.
 - b. Earthquake Seismic Requirements of CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
 2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
 3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance test seismic qualification of proposed switchboard and/or switch-gear shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
 4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
 - a. 110MPH-West Coast USA, California, and Hawaii, per ASCE/SEI 7-10.
 5. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and reports shall be certified, signed and “Stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.
- C. Equipment components/devices, switchboards, and/or switchgear shall be manufactured by: General Electric; or Cutler-Hammer; or Square-D; or Siemens.

PART 2 - PRODUCTS

2.01 BUSSING

- A. Horizontal and vertical busses shall be full lengths in each Equipment Section. Buses shall have a minimum short circuit fault withstand rating equal to available fault current indicated on Drawings, plus a 25% additional capacity (safety margin). However, in no case shall the rating be less than 50,000-amp, symmetrical.
- B. Provide interconnected full capacity neutral bus in each Section with the same ratings and construction as the phase busses.
- C. Provide interconnected ground bus in each Section.
- D. Provide space and all hardware and mounting attachments for future devices as indicated on the Drawings.
- E. Main horizontal phase and neutral bussing shall be full capacity in all equipment sections. The through bus of the end distribution section shall be extended and pre-drilled to allow the addition of future Sections.
- F. Vertical riser buss may be tapered, to not less than one third the ampacity rating of the main horizontal buss; but in no case shall the vertical buss be of less capacity than the sum of the frame size ampacities of over-current devices mounted in the respective sections including any indicated spares and spaces.
- G. The equipment bussing shall be of sufficient cross-sectional area to meet UL Standard 891 on temperature rise Bus shall be copper with silver plated bus joints or extruded aluminum with tin plated bus joints. The through bus shall have provisions for the addition of future sections. The through bus supports, connections and joints are to be bolted with Grade 5 hex head bolts and Belleville washers to minimize Maintenance Requirements.

2.02 CIRCUIT BREAKERS

- A. General
 - 1. Circuit protective devices as indicated on the Drawings. All devices shall have a short circuit interrupting capacity not less than the maximum available fault current at the circuit breaker and as indicated on the Drawings, plus a 25% additional capacity (safety margin). However, in no case shall the circuit breaker interrupting capacity be less than 30,000 amp symmetrical interrupting for 480/277 volt devices and 42,000 amp symmetrical for 240 volt or 208/120 volt devices.
 - 2. Provide padlock-off devices on each device. Breakers shall provide automatic time over-current and instantaneous circuit protection. Shall be suitable for use as "Main" service disconnect, "Feeder" and "Branch-Circuit" functions.
 - 3. Circuit breakers shall employ a self-powered stored energy, quick make-quick break, and trip free operating system on each phase, with common trip. Circuit breakers shall not trip in the event of short term or long term electrical power failure. Dead front cover accessible close-open controls, monitors and visual indicator flags.
 - 4. Circuit breakers noted as "100%" on the Drawings shall be tested and rated to carry the breaker full rated (100%) ampere load continuously including the assemblies the circuit breakers are installed into.

5. Provide conductor lugs for circuit protection devices to accept conductor temperature rating, sizes and quantities shown on Drawings. Circuit protection devices shall be UL listed suitable for normal and reverse feed.
6. Provide auxiliary contacts on circuit breakers. Auxiliary "DRY" contacts shall provide supervised remote monitoring of "Open-Close-Trip" circuit breaker status. Typical for circuit breakers supplying the following types of connected electrical loads.
 - a. Fire alarm equipment and devices.
 - b. Mass-evacuation equipment and devices.
 - c. HVAC smoke control and smoke evacuation equipment.
 - d. HVAC fire/smoke electrically operated dampers.
 - e. Intrusion detection and access control equipment and devices.
 - f. Elevators and escalators.
 - g. Fire sprinkler pumps.
7. Plug-in communications port for circuit breaker portable test instrument connects.
8. Circuit breaker data monitoring and communications:
 - a. The circuit protection devices shall monitor, communicate and report circuit voltage, ampere, power, and harmonic parameters for the respective connected circuit. The circuit protection device monitor and communication parameters shall be the same and compatible with the specified "METERING" devices.
 - b. Additionally the circuit protection devices shall monitor and communicate the respective device status as follows:
 - 1) Open/close/trip device status
 - 2) Ground fault trip status (where applicable)
 - c. Provide circuit breaker data monitoring and communications for each of the individual feeder protection devices and main protection devices located in switch-gear and switchboards, rated 400 amp or greater trip rating.
 - d. The respective "METER" display selection control functions shall provide selection and display of all information monitored and communicated by individual protection devices on the respective meter alphanumeric display.
9. Circuit breakers shall be Power Circuit Breaker type, Insulated Case Circuit Breaker type or Molded Case Circuit Breaker type. Time/current and instantaneous characteristics and selection of circuit breaker type shall comply with the recommendations in the coordination study and insure Optimal Code mandated time/current and instantaneous coordinated sequential tripping throughout the electrical system.

The Contract Document intent requires providing the selection and use of the circuit breaker types and performance characteristics for time/current and instantaneous trip coordination during electrical circuit overload conditions and during electrical short circuit fault conditions. Combined with the specified circuit breaker protection time/current performance characteristics.

- a. Insulated Case Circuit Breaker type-ICCB:
 - 1) NEMA-AB1 and AB3, comply with latest revision.
 - 2) UL-1087, UL-489 and IEC-60.947, comply with latest revision.
 - 3) 5Hz AC closing and 3Hz AC trip and clear.

- 4) Hybrid combination of Molded Case Circuit Breaker type and Power Circuit Breaker type circuit breakers. ICCB enclosed insulated housing and limited internal maintenance access.
 - 5) Two-step stored energy close mechanism.
 - 6) Extended function on-off instantaneous trip selection.
 - 7) Push-to-trip button.
 - 8) Mechanical operations counter.
- b. Molded Case Circuit Breaker type-MCCB:
- 1) NEMA-AB1 and AB3, comply with latest revision.
 - 2) UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
 - 3) 5Hz AC closing and 3Hz AC trip and clear.
 - 4) Sealed enclosed housing.
- B. Protection Performance Requirements for circuit breakers conforming to one or more of the following applications:
- 600 amp or larger frame size.
 - Larger than 400 amp trip.
 - Service entrance in main switchboard or switchgear.
 - Noted as Main or Main Circuit breakers on the Drawings.
1. Circuit breaker shall employ current sensors and solid-state static digital electronic automatic trip system. Three phase or single-phase operation as noted on the Drawings. Current carrying components shall be completely isolated from the static trip units. The trip unit shall be independent of external power sources. Circuit breakers shall be rated for reverse connection.
 2. Circuit breaker solid state digital trip control functions shall provide the following time/current curve shaping field adjustable features;
 - a. Adjustable ampere setting to vary the long-time continuous current carrying capacity, minimum range of 80% through 100% of full load trip rating.
 - b. Adjustable long-time delay setting to vary the time the breaker will trip under sustained over-load conditions. Minimum of three settings, "minimum – intermediate - maximum".
 - c. Adjustable short-time pickup to vary the level of high current the breaker can carry for short periods of time, minimum range of two times through eight times of ampere setting.
 - d. Adjustable short time delay to vary the time of the short-time pickup. Minimum of three settings "minimum-intermediate-maximum".
 - e. Short time " I^2t " switch to allow a current-squared multiplied by time ramp function in the short-time system. Two position setting "in-out".
 - f. Adjustable instantaneous pickup to vary the breaker ampere setting for immediate (instantaneous) interruption of severe overloads (short circuits). Adjustable minimum range of two times through nine times of circuit breaker ampere sensor rating. Instantaneous selective over-ride trip setting shall also include "on-off" function. When "off"; or "override" is selected, shall then function with the adjustable short time delay and adjustable short time pick-up (Note where the coordination study requires a higher instantaneous setting, change the specified

adjustable instantaneous trip to fixed instantaneous trip at fifteen times the breaker ampere sensor setting also with on-off function).

- g. Individual fault trip indicators (flags) shall provide local indication on the breaker for overload and short circuit (and ground fault where applicable) conditions.
 - h. Provide quantity of one Manufacturer's Standard Test set for solid state trip circuit breakers.
- C. Protection Performance Requirements for circuit breakers conforming to one or more of the following applications:
- Smaller than 600 amp frame size.
 - 400 amp and smaller trip.
 - Larger than 100 amp frame size.
 - Larger than 100 amp trip.
1. Circuit breaker shall employ current sensors and solid-state static digital electronic automatic trip system. Time/current curve shaping field adjustable features
 2. Solid state digital trip breakers shall conform to the Requirements described above for solid state breakers larger than 400 amp trip. However, only the following field adjustments are required;
 - a. Long-time ampere setting adjustable minimum range of 80% through 100% of full load trip rating.
 - b. Short time pickup adjustable minimum range of two times through eight times of the ampere setting.
 - c. Fixed or field adjustable instantaneous trip (depending on the results of the coordination study).
- D. Performance Requirements for circuit breakers conforming to the following applications:
- 100 amp frame size and smaller.
 - 100 amp and smaller trip.
1. Circuit breaker shall be fixed or adjustable instantaneous current trip with thermal-magnetic trip or with solid-state static digital electronic automatic time/over current automatic trip (depending on the results of the coordination study).
- E. Current Limiting Circuit Breakers (CLCB)
1. Protection Performance Requirements for circuit breakers conforming to the following applications:
 - 600 amp and smaller trip and identified as current limiting (CLCB) in the Contract Documents.
 - a. Current limiting circuit breakers shall be supplied in integral fully enclosed insulating housing construction and shall consist of a common trip, thermal-magnetic or solid state static digital trip conventional circuit breaker (Depending on the results of the coordination study), with an independently operating limiter section in series with each pole.
 - b. The conventional breaker section shall have an over center, trip-free, toggle-type mechanism with quick-make, quick-break action and positive handle indication. A button shall be provided on the cover for mechanically tripping the circuit breaker. The current limiting breaker shall have permanent trip units containing solid state static digital trip or individual thermal and magnetic trip elements, in each pole.

Calibrated for 40-degrees C ambient temperature. The limiter section shall consist of current limiting elements on each phase, electrically coordinated with the conventional circuit breaker trip elements. The contacts of the limiter section shall be electro-magnetically and electro-dynamically opened and held open until interruption is complete.

- c. Current and Energy Limitations: On high-level fault currents the limiter portion of the circuit breaker shall operate to limit the rise of fault current. Integral resistance shall be introduced into the faulted circuit to dissipate and limit let-through energy and to provide a voltage transient-free interruption at near unity power factor. The Let-through short circuit fault current and energy levels shall be less than that permitted by Underwriters Laboratories to a value less than I^2t of a half cycle wave of the symmetrical prospective current. The CLCB limiter shall limit the asymmetrical short circuit fault current below the equipment symmetrical short circuit fault current.
 - d. On fault currents below the threshold of current limitation, the normal non-limiter breaker section shall provide conventional time/current overload and short circuit fault protection.
2. Protection Performance Requirements for circuit breakers conforming to the following applications:
- Trip ratings over 600 amp through 5000 amp or less. Identified as current limiting (CLCB) in the Contract Documents.
 - a. Integrally fused circuit breaker integrated with solid state static digital electronic automatic trip. Combined standard circuit breaker providing overload-short circuit protection within its interrupting capacity and ON-OFF switching function and on each phase current limiters internally mounted on the load side of the circuit breaker, of such ratings that their time current limiting characteristics will coordinate with the time current tripping characteristics of the circuit breaker elements.
 - b. The coordination shall result in the interruption by the circuit breaker alone of fault level currents up to the interrupting capacity of the circuit breaker and interruption by the current limiter in conjunction with the circuit breaker of fault level currents above the interrupting capacity of the circuit breaker.
 - c. A removable cover shall be provided over the current limiter section of the integrally fused circuit breaker. The current limiter housing covers shall be interlocked with the breaker tripping mechanism to insure the breaker will trip upon removal of the cover. The cover shall be interlocked with the breaker to insure the circuit breaker cannot be turned to the ON position with the cover removed. Current limiters shall have a spring loaded plunger which, when the limiter blows, is released to actuate the circuit breaker common trip bar mechanism opening all breaker poles simultaneously.
 - d. The limiters shall be individually interlocked with the breaker element tripping mechanism to insure the limiter cannot be inserted until the breaker is in the OFF position. The circuit breaker and limiters shall be interlocked to insure the circuit breaker cannot be closed if a limiter is either missing or has blown.
 - e. Fuse limiters shall be individually removable from the circuit breaker housing.

- f. The circuit breaker shall be ambient temperature compensating. The circuit breaker shall be provided with thermal magnetic or solid state static digital trip (depending on the coordination study).
 - g. The integrally fused circuit breaker shall be capable of interrupting available short circuit currents up to 200,000 RMS symmetrical amperes at voltage up to 600 VAC.
 - h. Ratings, clearances and performance of the integrally fused circuit breaker shall be in accordance with applicable Standards of NEMA, IEEE and UL.
- F. Series Rated Circuit Breakers (SR)
- 1. Performance Requirements for circuit breakers conforming to the following applications:
 - a. 400-amp and smaller trip and identified as Series Rated (SR) on the Drawings. Circuit breakers shall be UL listed for series rating with all downstream circuit breakers.

2.03 SWITCH AND FUSE FEEDER PROTECTIVE DEVICES

- A. Fusible Switches: Quick-make, quick-break type with rejection clips for use with Class "R" fuses Current Limiting Fuses (CLF). Switches with ratings up to and including 100-amp at 240-volts shall be twins mounted. Switches rated through 60-amp and 480 volts shall be twins mounted. Shall be UL listed suitable for normal and reverse feed. Switches shall be removable from front of switchboard without disturbing adjacent units or switchboard bus structure.
- B. Fuses shall be time delay current limiting types, UL Class RK-1 unless otherwise indicated on the Drawings. Provide one spare set of fuses of each size and type in each switchboard.
- C. Provide auxiliary contact on switch for remote status (on-off) signaling and monitoring. Provide conductor lugs to accept conductor temperature rating, sizes, and quantities shown on Drawings.

2.04 GROUND FAULT PROTECTIVE SYSTEM AS FOLLOWS:

- A. One control power transformer rated 480/120 volts of suitable capacity for shunt tripping of the main circuit breaker and subfeed circuit breakers as indicated on the Drawings. Fuse transformer on the 480-volt side.
- B. Ground sensor current transformer for each indicated ground fault relay, zero sequence type with integral test winding for each circuit indicated on Drawings (the 3-phases and neutral conductor shall be brought through the current transformer window per Manufacturer's recommendations). Shall be UL-listed suitable for normal and reverse feed.
- C. One ground break, solid-state relay, and monitor and test panel for each device indicated on the Drawings. Pick-up adjustment shall be continuous 100 amp through 1200 amp; time adjustment shall be continuous from instantaneous through sixty cycles. Monitor panel shall indicate relay operation and provide means for system testing with or without interruption of service, and shall not permit system to be inadvertently left in an inactive or off state. Provide resettable trip indicators.
 - 1. Ground fault system shall provide selective trip coordination with other upstream/downstream ground fault and phase over current circuit protection devices as determined by the coordination study.
 - a. Ground fault protection devices shall incorporate adjustable time/current trip settings.

- b. Ground fault protection devices shall incorporate adjustable inverse time and very inverse time adjustable/selective settings.
- D. The ground fault system may be integrated into each circuit breaker with solid state trip units, in lieu of the separate specified ground fault relay and monitor panel system. The solid state circuit breaker ground fault system shall provide the identical specified operational features of the described separate system.
- E. Each circuit breaker 100 amp and larger, located in the main switchboard(s) and distribution switchboard or main switchgear where the main bus is larger than 800 amp and operating above 240 volt phase-to-phase, shall be provided with ground fault system whether or not shown on the Drawings. Provide all inter-connecting control power and interlocking wire in switchboards/switchgear and between switchboards/ switchgear for an operational system.

2.05 MAIN SWITCHBOARDS

- A. Switchboard shall be floor-mounted, dead-front, dead-rear type, front and rear aligned, self-supporting, consisting of one or more vertical sections with bussing, circuit protective devices, instrumentation, auxiliary devices and control wiring as indicated on the Drawings and as specified herein.
 - 1. Shall be utility and service entrance rated and approved.
 - 2. Switchboards shall employ mounting configuration for circuit protective devices as follows:
 - a. Group-mount, fixed position, non-drawout switchboards. Front access only, shall not require rear access. Typical for all circuit protective devices or as indicated on Drawings.
 - 3. Switchboards shall employ circuit breakers types and circuit protection devices as follows:
 - a. All Main circuit breaker of all frame sizes – ICCB type circuit breakers.
 - b. 800 amp and larger frame size Feeder circuit breakers, ICCB type circuit breaker.
 - c. Smaller than 800 amp frame size Feeder circuit breakers, ICCB type; or MCCB type circuit breakers.
 - d. CLCB type circuit breakers. CLCB circuit type only where noted on the Drawings.
 - e. CLF with switch and fuse type. CLF with switch and fuse type only where noted on the Drawings.
 - 4. Surge Protection Device – SPD
 - a. Provide a 3-phase, 5-wire SPD in the switchboard, with 30-amp 3-pole subfeed circuit breaker.
 - b. See Specifications Section 26 05 00 for SPD Additional Requirements.
- B. Switchboard shall be designed, built and tested in accordance with applicable portion of the latest editions of NEMA PB-2, Underwriters Laboratories No. UL-891 and the National Electrical Code. Rated for service-entrance operation.
- C. Switchboard Sections Configuration
 - 1. Floor standing self-supporting, of the universal frame type using die formed, 12-gauge steel members bolted and welded together.
 - 2. Provide removable side and rear plates with formed edges all around.

3. Provide ventilation openings required for maintaining nominal operating temperature.
 4. Provide removable steel cover plates for all usable device spaces. Provide lifting means and provisions for moving by means of rollers or skids to installation location.
 5. Bolt individual sections together to form a single rigid switchboard assembly.
 6. Provide full height, hinged, vertical wireway metal covers, on each vertical wireway, of each distribution section of the switchboard.
 7. Typical for all switchboards, distribution switchboards and switchgear.
- D. Switchboard shall include, but not be limited to, the following:
1. Underground pull section as required by the serving utility incoming service.
 2. Metering facilities as required by the serving utility.
 3. Current transformer space.
 4. Main disconnects devices.
 5. Distribution and feeder circuit protective devices.
 6. District metering (where indicated on Drawings).
 7. Bussing, incoming utility compliant and outgoing distribution.
 8. Surge Protection Device (SPD).

2.06 DISTRIBUTION SWITCHBOARDS

- A. Switchboards shall be floor mounted, dead-front, dead-rear type, front and rear aligned, self-supporting, consisting of one or more vertical sections with bussing, group mounted circuit protective devices, instrumentation and control wiring as indicated on the Drawings and as specified herein. Switchboards shall comply with UL Standard #UL-891 and NEMA-PB2.
1. Distribution switchboards shall be service entrance rated and approved, when located in a building separate and remote from the main service entrance switchboard.
 2. Distribution Switchboards shall employ circuit breaker types and circuit protection devices as follows:
 - a. All Main circuit breakers of all frame sizes - ICCB type circuit breakers.
 - b. 800 amp and larger frame size Feeder circuit breakers, - ICCB; or MCCB type circuit breakers.
 - c. Smaller than 800 amp frame sizes Feeder circuit breakers - ICCB; or MCCB type circuit breakers.
 - d. CLCB type circuit breakers, only where noted on the Drawings.
 - e. CLF with switch and fuse type. CLF with switch and fuse type only where noted on the Drawings.
- B. Distribution Switchboards shall include but not be limited to the following:
1. Main disconnect device (where indicated on Drawings).
 2. Feeder protective devices.
 3. District metering (where indicated on Drawings).
 4. Bussing.
 5. Transient Voltage Surge Protection (SPD).

C. Switchboard Sections

1. Floor standing, self-supporting, of the universal frame type using die formed, 12 gauge steel members bolted and welded together.
2. Provide removable side and rear plates with formed edges all around.
3. Provide ventilation openings required for maintaining nominal operating temperature.
4. Provide removable steel cover plates for all usable device spaces. Provide lifting means and provisions for moving by means of rollers or skids to installation location.
5. Bolt individual sections together to form a single rigid switchboard assembly.
6. Provide full height, hinged, vertical wireway metal covers, on each vertical wireway, of each distribution section of the switchboard.

2.07 MISCELLANEOUS INSTRUMENTS

- A. Instrument and Control Transformers: ANSI C57.13 and NEMA ST20 as applicable. Transformers shall be specifically designed for use on respective protective relay or metering schemes utilized.
- B. Current transformers meter/relay grade shall be multi-ratio tap, tap setting as indicated on Drawings, (minimum of three field adjustable tap settings) with 5 amp secondary, insulation class, 600 volt, 60Hz, single ring type, and shall have an accuracy classification of 0.3 with the burden of B.01, B.02 and B.03.
- C. Control and transfer switches shall be of the rotary, oil-tight multi-position, cam-operated, multi-stage type, with dust cover and silver-to-silver contacts rated 600 volts, 20-amp and adequate for the duty performed in excess of 10-amp. Equip each switch with engraved plastic escutcheon nameplate identifying its function and position.

2.08 CONTROL WIRING

- A. Terminal blocks with barriered terminals for each connection shall be provided for all control wiring terminator points. Control wiring shall be run in horizontal and vertical, isolated, internal metal wireways and shall be carried across hinges in laced bundles. Wire terminators shall be crimp-on type spade terminal
- B. Secondary control wiring shall be a minimum of 14AWG stranded copper type SIS 600-volt insulation.
- C. Control circuits shall have circuit number tags at each termination or break in the wire to match circuit numbers on terminal strips and control wiring diagrams.

2.09 WEATHERPROOF EQUIPMENT

- A. Equipment indicated as weatherproof (W.P.) or outdoors should be NEMA 3R, non-walk-in, tamper resistant construction. Provide full height hinged doors with provisions for padlocking the doors in the closed position.
- B. Provide a nominal 300-watt sealed, resistance type, anti-condensation heater in each equipment section. Heaters shall be controlled automatically by Thermostats and Humidistats. A circuit breaker shall be provided to supply switchboard buss voltage to the heaters, all prewired by the Manufacturer to fused terminals.

- C. Finish shall be electrostatically applied finish paint over iron oxide rust inhibitor primer. Finish color shall be Manufacturer's standard color, olive green Munsel #7GY3.29/1.5. The bottom side and bottom 6-inches of the equipment shall be coated with 4-mil minimum thickness rust inhibitor undercoating over finish paint, on all interior surfaces. Finish withstand test without face corrosion or blistering:
 - 1. Salt spray withstands - 2000 hours ASTM B117.
 - 2. Humidity withstands - 750 hour ASTM D2247.
- D. Exposed Hardware and Hinges Shall be Stainless Steel Type 302 or 304, Tamper Resistant

PART 3 - EXECUTION

3.01 GENERAL

- A. Install Equipment in accordance with Manufacturer's written instructions and applicable portions of NECA's "Standards of Installations" for switchboards, switchgear and motor control centers.
- B. Prior to Energizing and Testing, Manufacturer's Field Engineer shall visually inspect and verify devices are operational and bus connects complete.

3.02 ANCHORING

- A. Bolt Equipment to floor and wall where wall exists. Where units are free standing, provide preformed steel channel or angle iron bracing to nearest wall or building structural member.
- B. Equipment anchoring shall be designed for compliance with the earthquake seismic vertical and lateral acceleration of the equipment install location. Submit structural calculations and details.

3.03 FIELD TESTING INSPECTIONS AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

- A. Test all Equipment after the installation has been completed, and the District's Representative has been given 10-days' notice of the proposed tests. The Contractor shall provide operating tests demonstrating that all equipment and devices operate in accordance with the Requirements of the documents.
- B. Adjustable Settings
 - 1. Shall be set and tested after the equipment installation is complete, for proper operation at set points, pickup, and/or drop-out points. Shall be performed by an independent Test Laboratory and trained certified Technicians actively engaged in testing and using test instruments designed and manufactured for the purpose.
 - 2. Provide protection device settings and test, to insure operation and coordination as described in the time/current coordination final submittal, and in accordance with the Contract Documents.
 - 3. Calibrate and testing shall comply with the Equipment Manufacturer recommendations.
 - 4. Correct deficiencies, non-compliant equipment and retest to demonstrate compliance.
 - 5. Submit reports to District's Representative, six copies.
- C. Testing shall be completed in accordance with ANSI/NETA Standards.

3.04 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. Provide a red and white Bakelite nameplate with ½-inch high letters in each Section fastened to face of dead-front plate, to read: "DANGER 480 (actual volts) VOLTS, KEEP OUT, AUTHORIZED PERSONNEL ONLY".
- B. Manufacturer shall stencil the equipment name on each Device and Equipment Section to correspond to the identification of the Drawing.
- C. Devices mounted in equipment controlling protective devices shall be provided with nameplates indicating device controlled or monitored.

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SECTION 26 24 16

BRANCH CIRCUIT PANELBOARDS AND TERMINAL CABINETS

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Provide Manufacturers Catalog Data for Panels, Cabinets, and Circuit Breakers.
- B. Provide Shop Drawing showing Panel Circuit arrangements, size, voltage, ampacity, over-current protective devices, etc.
- C. Provide nameplate engraving schedule.
- D. Short Circuit, Coordination and Arc-Flash
1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and settings to provide the selective coordination within the limits of the specified equipment, per the latest applicable Standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric Arc-Flash Calculations as part of the Coordination Analysis recommendations.
 2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.
 3. The goal is to minimize an unexpected but necessary electrical system outage and Personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
 - a. IEEE-242, Recommended Practices for Protection and Coordination of Industrial and Commercial Distribution.
 - b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - c. IEEE-1584, Guide to Performing Arc-Flash Hazard Study.
 - d. CEC/NEC
 4. Electrical equipment including switchgear, switchboards, electrical panels, and control panels, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electrical-Arc-Flash" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by Personnel, to wear

the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” equipment and circuits.

1.03 SEISMIC EARTHQUAKE AND WIND LOADING WITHSTAND, TESTING AND CERTIFICATION. (ADDITIONAL REQUIREMENTS)

A. General

1. The complete panels and terminal cabinet assemblies; including circuit protection devices, meter, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
 - a. Wind loading all outdoor equipment locations.
 - b. Earthquake CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance test seismic qualification shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
 - a. 110MPH – West Coast USA and Hawaii, per ASCE/SEI 7-10.
5. Seismic Test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

B. Refer to Commissioning - Section 01 81 00 for Additional Requirements.

PART 2 - PRODUCTS

2.01 PANELBOARDS AND DISTRIBUTION PANELS

- A. Shall be flush or surface mounting as indicated with group -mount circuit protection devices as shown on panel schedule, hinged lockable doors, index cardholders and proper bussing.
 1. Panelboards shall comply with the latest versions:
 - a. NEMA – PB1.
 - b. UL – 50 and 67.
 - c. CEC/NEC.
 - d. ASTM-B187.
 2. Where indicated on the Drawings shall be furnished with subfeed breakers and/or additional conductor lugs, split bussing, contactors, time switches, relays, etc., as required.
 - a. Branch circuit panels up through 42-circuits shall be single section, to accommodate all of the circuits and components.

- b. Distribution panels shall be single section or multi-section, to accommodate all of the circuits and components.
 - 3. Panels shall be "Service-Entrance" equipment rated when the panel main incoming supply feeder originates from one of the following:
 - a. Originates outdoors exterior of the building in which the respective panel is located.
 - b. Originates from an electrical supply source not located in the same building as the respective panel.
- B. Housing and Painting, Panels and Terminal Cabinets
 - 1. Shall be finished with one coat of rust inhibitor zinc chromate and coat of primer sealer after a thorough cleaning.
 - 2. Finish color paint as selected by District's Representative where exposed to public view (e.g., corridors, covered passages, offices, etc.). Prime coated panelboard shall be painted to match surroundings after installation in public areas.
 - 3. Manufacturer's standard color in electrical rooms/closets, janitors, HVAC and storage rooms.
 - 4. Shall be fabricated of sheet steel of the following minimum gauges.
 - a. Full height hinged, locking door. Trim #12 gauge steel; enclosure - Code gauge steel.
 - b. Panels installed in indoor dedicated electrical equipment rooms and dedicated electrical equipment closets, omit full height hinged locking panel door. Dead front cover behind omitted panel door shall remain.
 - 5. NEMA-1 Metal Housing, for indoor locations.
 - 6. NEMA-3R Metal Housing, tamper resistant, for outdoor locations.
 - 7. Furnish all panels and terminal cabinets with the Manufacturers flush locks and keys except where indicated otherwise herein. Keys and locks shall be interchangeable for all panels. Provide two latches and two locks for door heights exceeding 36-inches.
 - 8. Fasten the trim to panel and terminal cabinets by means of concealed, bolted or screwed fasteners accessible only when the door is open.
- C. Panels 208/120 volt, three phase, 4-wire, S/N or 120/240 volt, single phase, 3-wire, S/N.
Branch Circuit Panel as manufactured by:
 - 1. Cutler Hammer "Pow-R-Line 1 or 2" Series
 - 2. General Electric "A" Series
 - 3. Square D "NF/NQ" Series
 - 4. Siemens "P1/P2" Series
- D. Distribution Panels as manufactured by:
 - 1. Cutler Hammer "Power-R-Line 3 or 4" Series
 - 2. General Electric "Spectra" Series
 - 3. Square D "I-Line" Series
 - 4. Siemens "P4/P5" Series

- E. Top and bottom gutter space shall not be less than 6-inches high. Provide 6-inches additional gutter space in all panels where double lugs are required, or where cable ampere size exceeds bus ampere size. Provide 12-inches additional gutter space in all panels for aluminum feeders where used.
- F. Panel Dimensions.
 - 1. Panels with buss sizes 50 amp thru 400-amp.
 - a. Shall be 20-inches wide. Surface or flush mounting as indicated.
 - b. Recess mounted type shall have a 20-inches wide (maximum) recess metal enclosure with overlapping edge trim plate cover extending 1-inch on all sides of enclosure.
 - c. Depth shall be 5.75-inches nominal. Height of panel as required for devices.
 - 2. Panels with buss sizes greater than 400-amp.
 - a. Narrow panels 24-inches (maximum) wide by 6.5-inches (maximum) deep units. Wide panels' 25-inches to 44-inches (maximum) wide by 8-inches to 15-inches (maximum) deep units. Nominal 90-inch panel height.
 - b. The wider units shall be used only at locations where the narrow unit is not available with the quantity or size of large-ampere frame branch/subfeed circuit protective devices shown on the panel schedules, or where the main breaker size exceeds the narrow panel maximum.
 - c. Distribution panels shall be floor standing and also supported from behind the panels at walls.
- G. Distribution panels and branch circuit panels maximum load rating
 - 1. Panelboards and Distribution Panels exceeding 800-amp load rating shall not be permitted.
 - 2. Provide Distribution Switchboards instead of Distribution Panels for bus load and circuit load ratings exceeding 800-amp.
- H. Panel Auxiliary Cabinets
 - 1. Panelboards shown on the Drawings with relays, time clocks or other control devices shall have a separate auxiliary metal barrier compartment mounted above panel.
 - 2. Panelboards with circuits controlled by low voltage remote control relays shall be provided with separate auxiliary cabinets to contain the relays, adjacent to the panel-board.
 - 3. Provide auxiliary cabinets with separate hinged locking door to match panelboard.
 - 4. Provide mounting subbase in cabinet for control devices and wiring terminal strips.
- I. Panels shall have a circuit index cardholder removable type, with clear plastic cover. Index card shall have circuit numbers imprinted to match circuit breaker numbers.
 - 1. The panel identification nameplate shall describe the respective panel name and voltage, corresponding to the Contract Documents.
 - 2. The electrical power source, name and location of each panel supply-feeder and supply equipment name shall also be identified and described on the respective panel name-plate.

- J. SPD – Surge Protection Device
1. Provide each of the following branch circuit panel and distribution panel types with a SPD and RF filtering:
 - a. 208/120 volt - single phase and/or three phase.
 - b. 120/240 volt - single phase.
 - c. 480/277 volt - single phase and/or three phase.
 - d. All distribution panels.
 2. The SPD shall be installed inside the respective panel housing and shall be factory connected to each main phase, ground and neutral bus inside the panel.
 3. The SPD monitor/annunciator indicators shall be visible only when the panel access door is in the open position.
 4. Provide a 20-amp 3-pole (2-pole for single-phase panels) branch circuit protection device in each panel for SPD connection.
 5. The SPD device and panel shall be UL labeled and listed for combined use. See related Specification Sections for Additional SPD Requirements.
- K. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements)
1. The complete panel/panelboard assembly; including circuit protection devices, housings /enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested for Wind Loading and Earthquake withstand.
 2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
 3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.
 4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading as follows:
 - a. 100MPH – West Coast States USA and Hawaii, per ASCE/SEI 7-10.
 5. Acceptance test seismic qualification of proposed panels and panelboards shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
 6. Seismic test shall be performed by a third party independent test laboratory. Wind Analysis and Seismic Testing and reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

2.02 SHORT CIRCUIT RATING

- A. Circuit protective devices and bussing as indicated on the Drawings. All devices and bussing shall have a short circuit fault withstand and interrupting capacity not less than the maximum available fault current at the panel and as indicated on the Drawings, plus a 25% additional capacity (safety margin). However, in no case shall the short circuit fault interrupting and withstand capacity be less than the following symmetrical short circuit.

	<u>C/B and/or Bus Rating</u>	<u>Circuit Voltage</u>	<u>Short Circuit Amp.</u>
1.	400A and less	240V and below	10,000A
2.	400A and less	over 240V and below 600V	14,000A
3.	Over 400A, 800A and below	240V and below	42,000A
4.	Over 400A, 800A and below	over 240V and below 600V	30,000A

- B. Panel Short Circuit Fault Rating

1. General
 - a. Provide a “fully rated” for short circuit fault interrupt and full load ampere main circuit breaker in each branch circuit panel and/or each distribution panel. Provide the main circuit breaker whether or not a main circuit breaker is shown otherwise on the Drawings, Schedules or Diagrams. The “utility-source” plus the “motor-load” transient contributions shall be used to establish the available fault duty values, unless indicated otherwise on the Drawings.
 - b. The panel main circuit breaker full load ampere capacity rating shall equal the respective panel main bus ampere rating.
 - c. The panel assembly, buss and circuit protection devices bolted fault short circuit withstand and bolted fault short circuit interrupt ratings shall not be less than 125% greater (including a 25% safety margin) than the available utility-source symmetrical and asymmetrical bolted fault short circuit current when “series combined rated” with the panel main circuit breaker.
 - d. The main circuit breaker rated “bolted-fault” short circuit fault interrupt and withstand short circuit rating shall not be less than 125% (including a 25% safety margin) of the upstream main service entrance “bolted-fault” available (symmetrical and asymmetrical) short circuit current.
2. Distribution Panelboards
 - a. Distribution panel, main circuit breaker, all feeder circuit breakers, and all branch circuit breakers shall be “fully-rated” (plus safety margin) for the available bolted fault short circuit current (including safety margin).
 - b. Shall provide time/current-tripping coordination with downstream equipment and upstream equipment.
3. Non-emergency branch circuit panelboards 400-amp buss and smaller; Non-emergency branch circuit panelboards 400-amp trip main circuit breaker and smaller.
 - a. The branch circuit panel main circuit breaker shall be “fully-rated” (plus safety margin) Current Limiting Circuit Breaker type (CLCB). Shall provide time/current-tripping coordination with upstream equipment.
 - b. The branch circuit panel main circuit breaker shall be “series-rated” with the panel downstream branch circuit devices and panel bussing. “The series-rating” shall

provide short circuit bolted fault current withstand protection and short circuit bolted fault interrupt rating protection during a downstream 3-phase line-to-line and/or single-phase line-to-ground short circuit bolted faults.

- c. Typical for branch circuit panelboards connected to normal-power (non-emergency) power circuits.
4. Emergency branch circuit panelboards 400-amp bus and smaller; Emergency branch circuit panelboards 400-amp trip main circuit breaker and smaller.
 - a. The branch circuit panel main circuit breaker shall be short circuit bolted fault “fully-rated” (plus safety margin) Non-Current Limiting circuit breaker type (non-CLCB).
 - b. The panel bussing shall also be short circuit bolted fault “fully-rated”.
 - c. All of the branch circuit panel, branch circuit breakers shall be “fully-rated” non-fused Current Limiting Circuit Breaker Type (CLCB). Shall provide short circuit bolted fault interrupt rating. Coordinated time/current and instantaneous tripping with the upstream circuit protection devices.
 - d. Typical for branch circuit panelboards connected to emergency power circuits.

2.03 PANEL CIRCUIT BREAKERS, CIRCUIT PROTECTION DEVICES

- A. Circuit Breakers General, for Distribution Panels and Panelboards
 1. NEMA-AB1 and AB3, comply with latest revision.
 2. UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
 3. 5Hz AC closing and 3Hz AC trip and clear.
 4. Main circuit breakers for distribution panels exceeding 400-amp and larger;
 - a. Shall be Insulated Case Circuit Breaker type ICCB.
 5. Main circuit breakers for branch circuit panelboards 400 amp buss and smaller;
 - a. Shall be Current Limiting Circuit Breaker type-CLCB for non-emergency panelboards.
 - b. Shall be Molded Case Circuit Breaker type-MCCB for emergency panelboards.
 6. Branch circuit breakers and feeder circuit breakers smaller than 100-amp trip shall be Molded Case Circuit Breakers type-MCCB and/or Current Limiting Circuit Breakers type-CLCB.
 7. All circuit breakers 100-amp and larger trip shall employ sensors and solid state digital electronic automatic trip system. Short-time and long-time time/current curve shaping field adjustable functions and adjustable instantaneous trip. Typical for Molded Case Circuit Breaker type-MCCB, Insulated Case Circuit Breaker type-ICCB and Current Limiting Circuit Breaker type-CLCB.
 8. Refer to Specification Section 26 24 13 and/or 26 11 00 for additional Circuit Breaker Requirements.
- B. Manufacturer
 1. Circuit breakers as manufactured by the following companies only are acceptable:
 - a. Cutler Hammer
 - b. General Electric Co.
 - c. Square D Co.
 - d. Siemens

C. Configuration

1. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the Drawings.
2. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs, which can readily be changed from front of panel, will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
3. Panelboard circuit protection devices shall be bolt on type for connection to panel bus. Removable and installable without disturbing adjacent devices.
4. Provide conductor wire terminations (lugs) on each circuit protection device for incoming main feeder, branch circuits and outgoing feeder circuits. Dual rated copper/aluminum and compatible with the respective conductor size, type, and quantity.
5. Where 2-pole or 3-pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
6. Branch circuit panels shall be field convertible for bottom entry main incoming feeder or top entry main incoming feeder.
7. Each panel section, the feeder and branch circuit protection devices (3-phase and/or 1-phase) shall be "twin-mount", side-by-side double row construction for the following circuit sizes:
 - a. 480/277 volt, 60-amp circuit size and smaller.
 - b. 240 volt – 208/120 volt, 100 amp circuit size and smaller.

D. Lock-Off and Lock-On

1. All circuit breakers shall be pad-lockable in the "off" position.
2. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall also be furnished with lockout clips, mounted in the "on" position. The breakers shall be able to trip automatically with lockout clips in place.
3. Provide lock-on clips on branch circuit breakers supplying fire alarm equipment and fire alarm panels. Provide identification of the dedicated "fire alarm" circuit function and operation. Color-code the circuit breakers to comply with AHJ Requirements.
4. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval. Other means of attachment shall not be accepted without prior written approval of the District's Representative.

E. Arc Fault Interrupter Circuit Breaker (AFCI-C/B)

1. AFCI-C/B provides automatic circuit interruption upon detection of any of these conditions: overload, short circuit fault and electric branch circuit arcing protection.
2. The AFCI-C/B shall detect intermittent "arcing" type electrical faults, and provide automatic circuit interruption (tripping).
3. Provide "test-pushbutton" on each C/B for manual AFCI-C/B Testing.
4. Single pole, 120-volt, 60Hz AC UL listed and labeled for installation in panelboard, #14 - #8AWG solid/stranded AL/CU load conductor.

F. Switch and Fuse Feeder Protective Devices for Distribution Panels

1. Locations where the Drawings show distribution panels employing switch-fuse circuit protection devices.
2. Fusible Switches: Quick-make, quick-break type with rejection clips for use with Class “R” fuses Current Limiting Fuses (CLF). Switches with ratings up to and including 100-amp at 240 volts shall be twins mounted. Switches rated through 60 amp and 480 volts shall be twins mounted. Provisions for padlocking in the “on” and/or “off” positions. Switches shall be removable from front of panel without disturbing adjacent units or panel bus structure.
3. Fuses shall be time delay current limiting types, UL Class RK-1 unless otherwise indicated on the Drawings. Provide one spare set of fuses of each size and type in each Distribution Panel.
4. Provide auxiliary contact on switch for remote status (on-off) signaling and monitoring. Provide conductor lugs to accept conductor temperature rating, sizes and quantities shown on Drawings.
5. Switch and fuse devices shall be permitted only in distribution panels and only where specifically indicated on the Drawings for feeders.

2.04 PANEL BUSSING

A. Bus Material

1. Bussing shall be rectangular cross section tin-plated copper or alternately silver or tin-plated aluminum.
2. Bussing shall be non-tapped, full length of the enclosure.

B. Ground Bus

Each panel shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

C. Provisions

Provide space and all hardware and bus mounting attachments for future devices as indicated on the Drawings.

D. Neutral Bus

The ampere rating of the neutral bus of panels and distribution panels shall be a minimum of 100% greater ampere capacity than the ampere rating of the corresponding phase bus, where the panel is indicated to be provided with an “oversize-neutral” or “200%” neutral on the Drawings.

2.05 TERMINAL AND AUXILIARY CABINETS

A. Cabinets

1. Fabricated of Code gauge sheet steel for flush mounting (except where noted as surface) of size indicated on the Drawings, and complete with hinged lockable doors, provide the quantity of 2-way feed through conductor terminals required for termination of all conductors, plus 15% spares of each type.

2. Cabinet locks to operate from same key used for panelboards. The trim to cabinets shall be fastened by means of concealed bolted or screwed fasteners accessible behind door into cabinets. All cabinets shall have 5/8-inch plywood backing, finished with fireproof intumescent primer and finish coat paint. Provide equipment ground bus in each cabinet.
 3. Cabinets shall be finished with one coat of zinc chromate and one coat of primer sealer after a thorough cleaning. Where exposed to public view (e.g., corridors, covered passages, offices, etc.) finish color paint to match surrounding and Manufacturer's standard gray color in switchboard, janitors, heater and storage rooms.
 4. Provide grounded metal barriers inside cabinet to isolate and separate line voltage and low voltage from each other inside the cabinet.
- B. Cabinet Dimensions.
1. Unless indicated otherwise on Drawings.
 - a. Shall be 20-inches wide. Surface or flush mounting as indicated.
 - b. Recess mounted type shall have a 20-inches wide (maximum) recess metal enclosure with overlapping edge trim plate cover extending 1-inch on all sides of enclosure.
 2. Depth shall be 5.75-inches nominal. Height of cabinet as required for devices, plus 25% spare unused interior space for future use, but not less than 36-inches high.
- C. Terminals
1. Non-digital analog circuits; line and low voltage modular signal systems, 15-amp dual row with isolation barriers, screw-down terminals insulated strips, heavy duty.
 - a. As manufactured by Molex, or ITT-Cannon, or General Electric.
 2. Digital circuits; low voltage signal systems, ANSI/EIA/TIA Category-6, 110-Block or 66-Block gas-tight punch down style, heavy duty.
 - a. As manufactured by: Leviton, or Ortronics, or AMP.
- D. Identification (Additional Requirements)
1. Provide engraved nameplate on each cabinet indicating its designation and system (i.e., "Life Safety System - Panel 2LS", etc.).
 2. Identify each terminal landing with unique circuit number and provide corresponding alphanumeric text-index card inside panel access door

PART 3 - EXECUTION

3.01 MOUNTING

- A. Flush Mounted Panelboards and Terminal Cabinets shall be securely fastened to at least two studs or structural members. Trim shall be flush with finished surface.
1. Panels and cabinets installed flush (recess or semi-recess) into fire rated or smoke rated walls. The wall recess shall be fully wrapped inside the recess with fire/smoke rated materials. The wrap-materials shall provide the same fire and/or smoke protection rating as the respective wall.
- B. Surface Mounted Panels and Terminal Cabinets shall be secured to walls by means of preformed galvanized steel channels securely fastened to at least two studs or structural members.

- C. Panelboards and Terminal Cabinets shall be installed to insure the top circuit protective device (including top compartment control devices) are not more than 6-feet-6-inches above finish floor in front of the panel and the bottom device is a minimum of 12-inches above the floor. Manufacturer shall specifically indicate on Shop Drawing submittals each panel where these conditions cannot be met.

3.02 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. Provide a red and white Bakelite nameplate with ½-inch high letters in each 277/480 volt panel fastened to face of dead-front plate, to read: "DANGER 480 (or as applicable) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY".
- B. Manufacturer shall stencil the panel/cabinet number identification on the inside of door to correspond with the designation on the Drawings.
- C. Identification plates and numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind shall not be used.

3.03 SPARE CONDUITS (ADDITIONAL REQUIREMENTS)

Provide three 1-inch conduit only stubs from each panel and terminal cabinet into accessible ceiling space. Where floor level below panel or terminal cabinet is accessible, also provide an additional three 1-inch conduit only stubs into accessible floor space.

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SECTION 26 24 19
MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment necessary for, and incidental to, performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Provide Schematic "Ladder-Type" Logic Control Wiring Diagrams and "point-to-point" control wiring diagrams showing the control system for HVAC equipment and other electrical equipment.
- B. Provide Nameplate Engraving Schedule.
- C. Submit Full-Scale Time/Current Transparencies on log/log paper for all fuses, circuit breakers, ground fault system devices, and relays.
- D. Short Circuit, Coordination and Arc-Flash
 - 1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings to provide the coordination within the limits of the specified equipment, per the latest applicable Standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric Arc-Flash calculations as part of the Coordination Analysis recommendations.
 - 2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.
 - 3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
 - a. IEEE-242, Recommended Practices for Protection and Coordination of Industrial and Commercial Distribution.
 - b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - c. IEEE-1584, Guide to Performing Arc-Flash Hazard Study.
 - d. CEC

4. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electrical-Arc-Flash" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working "Live", or operating "Live" electrical equipment and circuits.

PART 2 - PRODUCTS

2.01 GENERAL

A. Division 24 HVAC/Plumbing

Refer to Division 26 Mechanical and Plumbing Contract Documents and Shop Drawings for Additional Electrical Work and Material Requirements.

1. Provide all control devices including timeswitches, relays, auxiliary contacts, voltage transformers, and interlocks.
2. Provide all raceways, conduit wire, circuits, outlets, and interconnections of starters as required for HVAC and Plumbing systems.

B. Special Considerations

1. Mount all auxiliary relays and timeswitches in an isolated compartment inside motor control equipment unless otherwise indicated.
2. Whether or not shown on Mechanical and Plumbing Contract Documents and/or control schedules, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, provide each magnetic motor starter with a "Hand-Off-Auto" selector switch in starter cover. Other magnetic motor starters provide a "Start-Stop" push-button station in starter cover.
3. Motor starters, motor controllers and circuit feeder tap devices for motor circuits shall be rated and labeled for control of all electric motor design types A, B, C, D, and E pursuant to the Requirements of the NEC

C. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements)

1. The complete motor control equipment assembly; including circuit protection devices, motor controllers, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
 - a. Wind loading for outdoor locations.
 - b. Earthquake Withstand and CBC Seismic Withstand all indoor and all outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.

4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
 - a. 110MPH-West Coast States USA and Hawaii, per ASCE/SEI 7-10.
 5. Acceptance Test Seismic Qualification of proposed motor control equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
 6. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.
- D. Motor Control Equipment as Manufactured by:
General Electric; or Square D; or Cutler-Hammer; or Allen-Bradley; or Siemens.

2.02 MANUAL MOTOR STARTERS

- A. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one for each motor lead). Back boxes shall be supplied with all flush mounting starters, whether they are toggle type requiring only a 4-inch square outlet box or the larger type requiring a special box. Provide cover designed to accept the particular unit.
- B. Unless otherwise noted on the Drawings, all manual starters for single phase motors, smaller than 1 h.p. shall be the compact toggle type. Manual starters for all single phase motors, 1 to 5 h.p. and all three phase motors up to 5 h.p. shall be the heavy-duty type.
- C. Where Manual Motor Starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet with engraved nameplate to indicate function of pilot light. Pilot lights shall be push-to-test style.

2.03 FEEDER TAP DEVICES

- A. General
 1. Feeder tap devices shall be coordinated with the motor starter unit’s electrical and mechanical characteristics. Operating handle shall be accessible and operable from the unit front with positive visible indication of the on, off and tripped operating handle positions.
 2. Feeder tap devices shall have a short circuit and motor locked rotor interrupting capacity, series rated with the respective motor starter of not less than the maximum available fault current at the device as indicated on the Drawings, but in no case shall the interrupting capacity be less than 30,000 amp symmetrical interrupting for 480/277 volt devices and 42,000 amp symmetrical for 240 volt or 208/120 volt devices. Provide four key interlocking and padlock-off devices on each feeder tap unit.
 3. Feeder tap device (i.e. circuit breakers, switch and fuse or motor circuit protector) shall be as indicated on the Drawings. Where feeder tap device type is not indicated, provide switch and fuse type device.

4. Circuit breakers shall provide time overcurrent and instantaneous circuit protection. Motor circuit protectors shall provide instantaneous magnetic only circuit protection. Feeder tap devices shall be UL component listed and rated with the respective motor starters.
 5. Feeder tap device shall provide an auxiliary contact to automatically connect and disconnect control power when the feeder tap device is open, tripped or closed.
 6. Provide an auxiliary contact on feeder tap device for remote status (on-off) signaling and monitoring.
 7. Provide conductor lugs to accept conductor temperature rating, sizes, and quantities shown on the Drawings.
- B. Feeder Tap Devices shall be as indicated on the Drawings:
1. Circuit breaker feeder tap
 - a. Circuit breakers shall employ a stored energy, quick make-quick break, and trip free operating system on each phase, with common trip. Breakers shall comply with UL 489 and 1087, NEMA AB1 AB3 latest revisions. Circuit breakers noted as "100%" on the Drawings shall be rated to carry the breaker full rated (100%) ampere load continuously.
 - b. Protection Performance Requirements for circuit breakers conforming to one or more of the following applications:
 - 600-amp or larger frame size.
 - Larger than 400-amp trip.
 - Service entrance motor control center.
 - Noted as main circuit breakers on the Drawings.
 - 1) Circuit breaker shall employ current sensors and solid state static digital electronic automatic trip system. Three-phase or single-phase operation as noted on the Drawings. Current carrying components shall be completely isolated from the static trip units. The trip unit shall be independent of external power sources. Circuit breaker shall be UL listed for reverse connection.
 - 2) Circuit breaker solid state trip control functions shall provide the following time /current curve shaping field adjustable features;
 - a) Adjustable ampere setting to vary the long-time continuous current carrying capacity, minimum range of 80% through 100% of full load trip rating.
 - b) Adjustable long-time delay setting to vary the time the breaker will trip under sustained overload conditions. Minimum of three settings, "minimum-inter-mediate-maximum".
 - c) Adjustable short-time pickup to vary the level of high current the breaker can carry for short periods of time, minimum range of 2 times through 8 times of ampere setting.
 - d) Adjustable short time delay to vary the time of the short-time pickup. Minimum of three settings "minimum-intermediate-maximum".
 - e) Short time "I²t" switch to allow a current-squared multiplied by time ramp function in the short-time system. Two position setting "in-out".

- f) Adjustable instantaneous pickup to vary the breaker ampere setting for immediate (instantaneous) interruption of severe overloads (short circuits). Adjustable minimum range of 2.0 times through 13 times of circuit breaker ampere sensor rating. Circuit breaker shall incorporate adjustable instantaneous trip settings to allow coordinated instantaneous trip settings when protecting energy efficient motors.
 - g) Individual fault trip indicators shall provide local indication on the breaker for overload and short circuit (and ground fault where applicable) conditions.
 - h) Provide one Manufacturer standard test set for solid state trip circuit breakers.
- c. Protection Performance Requirements for circuit breakers conforming to one or more of the following applications:
- Smaller than 600 amp frame size.
 - 400 amp and smaller trip.
 - Larger than 100 amp frame size.
 - Larger than 100 amp trip.
- 1) Circuit breaker shall employ current sensors and solid-state static digital electronic automatic trip system. Time/current curve shaping field adjustable features.
 - 2) Solid state trip breakers shall conform to the Requirements described above for solid state breakers larger than 400 amp trip. However, only the following field adjustments are required;
 - a) Ampere setting adjustable minimum range of 80% through 100% of full load trip rating.
 - b) Short time pickup adjustable minimum range of 2 times through 8 times of the ampere setting.
 - c) Adjustable instantaneous trip (circuit breaker shall incorporate adjustable instantaneous trip settings to allow coordinated instantaneous trip settings when protecting energy efficient motors).
- d. Performance Requirements for circuit breakers conforming to the following applications:
- 100-amp frame size and smaller.
 - 100-amp and smaller trip.
- 1) Circuit breaker shall be fixed or adjustable instantaneous trip with thermal-magnetic trip or with solid-state static digital electronic automatic time/over current automatic trip depending on the results of the Coordination Study.
- e. Current Limiting Circuit Breakers (CLCB):
- 1) Performance Requirements for circuit breakers conforming to the following applications:
 - 600 amp and smaller trip and identified as Current Limiting (CLCB) on the Drawings.
 - a) Current Limiting Circuit Breakers shall be supplied in unit molded case construction and shall consist of a common trip, thermal-magnetic or solid state trip circuit breaker with an independently operating limiter section in series with each pole.

- b) The conventional breaker section shall have an over center, trip-free, toggle-type mechanism with quick-make, quick-break action and positive handle indication. A button shall be provided on the cover for mechanically tripping the circuit breaker. The current limiting breaker shall have permanent trip units containing solid state static digital trip or individual thermal and magnetic trip elements in each pole. Calibrated for 40 degrees C ambient temperature. The limiter section shall consist of three current limiting elements electrically coordinated with the conventional circuit breaker trip elements. The contacts of the limiter section shall be electro-magnetically and electro-dynamically opened and held open until interruption is complete.
 - c) Current and Energy Limitations: On high-level fault currents the limiter portion of the circuit breaker shall operate to limit the rise of fault current. Integral resistance shall be introduced into the faulted circuit to dissipate and limit let-through energy and to provide a voltage transient-free interruption at near unity power factor. The Let-through short circuit fault current and energy levels shall be less than that permitted by Underwriters Laboratories to a Value less than I^2t of a half cycle wave of the symmetrical prospective current. The CLCB limiter shall limit the Asymmetrical short circuit fault current below the equipment symmetrical short circuit fault current.
 - d) On fault currents below the threshold of current limitation, the thermal-magnetic breaker section shall provide conventional overload and short circuit protection.
- 2) Performance Requirements for circuit breakers conforming to the following applications:
- Trip ratings over 600-amp identified as Current Limiting (CLCB) on the Drawings.
 - a) Integrally fused circuit breaker integrated with solid state static digital electronic automatic trip. Combined standard circuit breaker providing overload-short circuit protection within its interrupting capacity and ON-OFF switching function and on each phase current limiters internally mounted on the load side of the circuit breaker, of such ratings that their time current limiting characteristics will coordinate with the time current tripping characteristics of the circuit breaker elements.
 - b) The coordination shall result in the interruption by the circuit breaker alone of fault level currents up to the interrupting capacity of the circuit breaker and interruption by the current limiter in conjunction with the circuit breaker of fault level currents above the interrupting capacity of the circuit breaker.
 - c) A removable cover shall be provided over the current limiter section of the integrally fused circuit breaker. The current limiter housing covers shall be interlocked with the breaker tripping mechanism to insure the breaker will trip upon removal of the cover. The cover shall be interlocked with the breaker to insure the circuit breaker cannot be turned to the ON position with the cover removed. Current limiters shall have a spring loaded plunger which, when the limiter blows, is released to actuate the circuit

breaker common trip bar mechanism opening all breaker poles simultaneously.

- d) The limiters shall be individually interlocked with the breaker element tripping mechanism to insure the limiter cannot be inserted until the breaker is in the OFF position. The circuit breaker and limiters shall be interlocked to insure the circuit breaker cannot be closed if a limiter is either missing or has blown.
 - e) Fuse limiters shall be individually removable from the circuit breaker housing.
 - f) The circuit breaker shall be ambient temperature compensating. The circuit breaker shall be provided with thermal magnetic or solid state static digital trip (depending on the coordination study).
 - g) The integrally fused circuit breaker shall be capable of interrupting available short circuit currents up to 200,000 RMS symmetrical amperes at voltage up to 600 VAC.
 - h) Ratings, clearances and performance of the integrally fused circuit breaker shall be in accordance with applicable Standards of NEMA, IEEE and ASA.
2. Switch and fuse feeder tap:
- a. Fusible Switches: Quick-make, quick-break type with rejection clips for use with Class "R" fuses. Switches shall be removable from front of equipment without disturbing adjacent units or equipment bus structure.
 - b. Fuses shall be time delay current limiting types, UL Class RK-1 for motor circuits unless otherwise indicated on the Drawings. Provide one spare set of fuses of each size and type in each switchboard.
 - c. Provide auxiliary contacts on switch for remote status (on-off) signaling and monitoring.

2.04 MOTOR STARTERS - 50/60HZ AC INDUCTION ELECTRIC MOTORS

A. General

- 1. Motor starters shall be horsepower rated for the motor connected to the starter, air insulated, with NEMA rating.
- 2. Motor starter coils and controls shall be designed to operate on the control voltage indicated on the Control Diagrams and Specifications. The motor starters shall reliably pick-up and seal-in at 80% through 110% of their coil control voltage.
- 3. Under voltage release for motor starter coil circuit shall automatically drop motor starter off the line when the line voltage drops below normal operating voltage. Under voltage release shall be field adjustable 80% to 95% of nominal voltage with field adjustable dropout delay 0.1 to 3 seconds minimum for starters larger than NEMA Size 1. The under voltage release shall reset automatically when line voltage level returns too normal. The reset time delay shall be a 0.1 to 60-second field adjustable time range for starters larger than NEMA Size 1.
- 4. Each motor starter control circuit shall be independently fused.
- 5. Three-phase motor starters controlling three-phase motors, 5-horsepower and larger shall provide integral motor single phasing protection. The starter shall automatically "open", turn off electrical power to the connected motor in the event of the loss of one

or more circuit phases, lock out and require manual resetting of the single phase protection to restart the magnetic motor starter. Provide single-phase annunciator. Provide adjustable time delay, minimum range 0.1 to 3 seconds for initiating single phase shut down.

6. Starter units shall be equipped with individual control power transformers (grounded type) with secondary and primary control power fuses. One secondary lead shall be grounded in the unit.
 - a. The unit disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.
 - b. The control power transformer VA load rating shall include the motor starter, additional internal and external control devices connected to the motor starter, to insure control power voltage drop does not exceed 5% of nominal rating.
7. Starter units shall be equipped with three motor overload elements, one for each phase, with automatic lockout, external overload indicating flag/pilot light and manual reset external push-button. Trip rating characteristics of the overload elements shall be as recommended by Motor Manufacturer.
 - a. Motor overload protection relays shall be bi-metal (non-melting) "heater-element" type or solid-state type, for motor starters NEMA Size 1 and smaller.
 - b. Motor overload protection relays for motor starters larger than NEMA Size 1 shall be solid-state type.
8. Pilot light indicators shall be provided with "Push-to-Test" feature. Provide a capacitor in parallel with the starters stop-start control relay circuit, to permit the motor starter control circuit to "drop-out" (turn-off) and prevent "capacitive-holding" (capacitive coupling) on control circuits with "long" (excessive distance) control circuit wiring.
9. Each starter shall be equipped with a minimum of one normally open and one normally closed auxiliary spare contact. Provide additional auxiliary control contacts for interlocking with system control circuits as indicated on the Drawings and Specifications. Auxiliary contacts shall be field convertible for normally open or normally closed operation. Contacts shall be rated not less than 10-amp at 120 volt 60Hz, AC, but in no case shall the auxiliary contacts be rated for less ampere or lower voltage than the connected control circuit.
10. Motor starters larger than NEMA Size 1, provide a running time meter 0 to 99999 hours minimum range, and an operations counter 0 to 9999 meter minimum operations start count range. Meters shall be field resettable with maintained memory during power outages of any length.
11. Minimum starter size shall be NEMA 1, but in no case less than indicated on the Drawings or Specifications.
12. Verify the exact Motor Connection Requirements; motor locked rotor/full load current, NEMA Code letter and voltage characteristics with the Supplier of each motor. Motor starters shall comply with the Identified Requirements.
13. Each starter shall be equipped with "Hand-off-Auto" switch or stop-start push-button as required.

14. An auxiliary relay contact for remote alarm annunciation shall provide common trouble annunciation for any of the starter automatic protection systems. The alarm contact shall automatically reset when the starter is reset.
 15. Provide each motor starter main "start" control relay or starter coil as applicable, with a magnetic coil auxiliary control "pilot" relay. The contacts of the auxiliary control relay shall directly control the starting, running and stopping control voltage of the motor starter main control coil circuit. The coil of the auxiliary relay shall condition and match the voltage and inrush of each motor starter to the Requirements of the incoming control circuit.
 16. Provide a transient surge suppressor for each motor starter coil, to limit voltage transients induced by the motor starter coil operation and to protect the motor starting circuit from voltage transients.
 17. Motor starters connected to engine generator emergency power supply source (either direct connection or connection through an automatic transfer switch) shall each be provided with a field adjustable (0.1 - 180 seconds) "start" (on delay) time delay, to provide "staggered" sequenced starting of the connected motor load.
- B. Full Voltage Non Reversing (FVNR), Unless Noted Otherwise
1. Across the line full voltage magnetic electromechanical motor starter.
 2. Provide FVNR motor starter for motor sizes through 50-horsepower (241 to 600 volt) and through 30-horsepower (240 volt and under) where the motor is connected to normal power utility source, unless noted otherwise on Drawings.
- C. Two Speed Motor Starters
1. The two speed motor starters shall be compatible with the connected motor and shall provide automatic two speed control of separate high speed and low speed motor winding or consequent pole two speed motors as applicable. The starters shall be constant horsepower, constant torque or variable torque as applicable for the motor connected to the starter.
 2. Low speed compelling control shall compel the motor starter to always start the motor on low speed before switching to high speed. Compelling control shall be manual switch selectable as either "in" or "out" (bypass) of the motor control circuits.
- D. Reduced Voltage Non-Reversing (RVNR)
1. General
 - a. The reduced voltage starter shall reduce both motor starting current and motor starting torque.
 - b. Reduced voltage starters shall be closed transition types.
 - c. Provide RVNR motor starters for motors larger than 30-horsepower (240 volt and below) and larger than 50-horsepower (over 240 volts), reduced voltage type (Where the motor starter circuit is connected to engine generator emergency power source for motors larger than five horsepower, provide each respective motor with RVNR reduced voltage motor starters).
 - d. Starters shall provide field adjustable time periods for acceleration (reduced voltage) and transition (transfer to full voltage) modes, with failure to transfer lockouts and pilot light annunciators. Adjustable time range shall be 0.1 to 15 seconds.

- e. Duty cycle - NEMA rated medium duty, starters shall provide for not less than one 15-second duration starter operation in each 4-minute interval for a 1-hour period, followed by a cool down rest period of 2-hours before the duty cycle is repeated. Provide automatic temperature lockout to prevent exceeding starter duty cycle.
 - f. Reduced Voltage Non-Reversing RVNR Motor starters shall be types described in the following paragraphs.
2. Autotransformer type reduced voltage starter
 - a. Auto transformers on each phase with field adjustable transformer voltage taps for 50%, 65%, and 80% motor terminal starting voltages.
 - b. Magnetic electromechanical motor contactor type.

2.05 COMBINATION MOTOR STARTERS

A. General

1. Combination motor starters shall consist of a feeder tap device, motor starter and enclosure. Voltage and amperage rating as indicated on Drawings.
2. Combination motor starter shall not be less than NEMA Size 1, but in no case less than indicated on the Drawings.
3. Unit shall be self-contained floor standing, wall mounted NEMA 1 enclosures or as indicated on the Drawings. Constructed, tested and listed in accordance with NEMA, ANSI and UL Standards.
4. Combination motor starters as manufactured by General Electric, Westinghouse, Square D, Cutler Hammer or equal.
5. Provide incoming line and outgoing load terminations, size and capacity to match connections shown.

B. Construction

1. NEMA styles metal enclosed, with full height hinged access door. 12-gauge welded frame members and 14 gauge panel members. All parts shall be removable and accessible from the front for ease of maintenance and rearrangement.
2. Provide removable lifting points and permanent anchor mounting points on the enclosure.
3. Hinged doors shall be mounted with removable pin hinges and secured with quarter turn indicating fasteners. A door interlock with manual defeat override shall prevent access to unit interior when the feeder tap device is in the "on" position.
4. Each metal surface shall be phosphatizing prime rust inhibitor painted and Baked Enamel Finish Painted Manufacturer's standard color.

C. Combination Motor Starter Short Circuit Coordination Protection

The combination motor starter shall be constructed and tested to comply with the following Requirements.

1. Type 1 Coordination:

Under short circuit conditions the contactor/motor starter shall cause no danger to persons or installation. Continued re-use shall be permitted after service, repair or replacement of parts.

2. Type 2 Coordination:
 - a. Under short circuit conditions the contactor/motor starter shall cause no danger to persons or installation. Continued re-use shall be permitted without requiring any service, repair or replacement of parts.
 - b. Motor starters shall also comply with International Electromechanical Committee (IEC) Type-2 short circuit protection, as recommended by the Manufacturer's published protection tables and as certified by UL.
- D. Energy Efficient Motor Protection
 1. Where a combination motor starter is connected to a high efficiency motor, provide one of the following modifications to the starters or circuit disconnects. The modification shall prevent unnecessary tripping from locked rotor high inrush motor starting current:
 - a. Circuit breaker or MCP short circuit protection - Provide Circuit Breaker/MCP with adjustable magnetic current trip for high inrush motor starting current, or adjustable time delay trip for high magnetic current motor inrush damping.
 - b. Switch and fuse motor short circuit protection - Provide fuses with sufficient inherent time delay to allow passage of high magnetic current inrush motor starting current.

PART 3 - EXECUTION

3.01 MOTOR CONTROL AND INDIVIDUAL COMBINATION MOTOR STARTERS

- A. Install Motor Control Equipment in accordance with Manufacturer's written instructions and applicable portions of NEMA "Standards of Installations" for switchboards and motor control centers and individual motor starters.
- B. Bolt Motor Control Equipment to floor and wall where wall exists. Where units are free standing provide preformed steel channel or angle iron bracing to nearest wall or building structural member. Motor control equipment anchoring shall be designed for a 1.0 gravity lateral acceleration of the equipment. Submit structural calculation and details.

3.02 IDENTIFICATION

- A. Provide a red and white bake lite nameplate with ½-inch high letters fastened to face of dead-front plate, to read: "DANGER 480 (actual volts) VOLTS, KEEP OUT, AUTHORIZED PERSONNEL ONLY".
- B. Manufacturer shall stencil the panel number and name of the connected motor circuit on each device and equipment section to correspond to identification on the Drawing.
- C. Identification plates and numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind as the only method of attachment shall not be used.

3.03 SETTINGS AND ADJUSTMENTS

- A. Program and Set Control Function Sequences, time delays, and protective device settings for correct system operation.
- B. Test all Timing, Control Sequences and motor rotation direction for proper operation. Correct Deficiencies and Retest until proper operation is confirmed.

END OF SECTION 26 24 19
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SECTION 26 33 53
UNINTERRUPTIBLE POWER SUPPLY - UPS

PART 1 - GENERAL

1.01 WORK INCLUDED:

All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for an incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

- A. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
- B. General Provisions and Requirements for Electrical Work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit Detailed Shop Drawings including Dimensioned Plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature.
- B. Submit Transformer Test Reports.
- C. System Configuration with Single Line Diagrams, show both internal and external wiring connections on Single Line Diagrams.
- D. All Circuit Breakers and Fuses shall be identified by location, frame size, trip rating and Manufacturer with type number, terminal locations and interconnect wiring diagrams. Submit engineered settings for all UPS adjustments, protection devices, time-outs, alarm pickup-drop-out, software controls etc.
- E. Size and Weight of Individual Shipping Units, weight dimensions and heat dissipation of each unit.
- F. Detailed Descriptions of Equipment to be furnished, including all deviations from the Contract Document Requirements.
- G. Detailed Layouts of all metering, alarm and mimic panels. Monitoring and metering sensing points shall be shown on the single line diagram.
- H. Short Circuit, Coordination and Arc-Flash (Additional Requirements)
 - 1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings to provide the coordination within the limits of the specified equipment, per the latest applicable Standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric Arc-Flash calculations as part of the Coordination Analysis recommendations.
 - 2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.

3. The goal is to minimize an unexpected but necessary electrical system outage and Personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
 - a. IEEE-242, Recommended Practices for Protection and Coordination of Industrial and Commercial Distribution.
 - b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - c. IEEE-1584, Guide to Performing Arc-Flash Hazard Study.
 - d. CEC
- I. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements).
 1. The complete Uninterruptable Power System assembly; including circuit protection devices, inverters, batteries, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
 - a. Wind loading all outdoor equipment locations.
 - b. Earthquake Seismic Requirements of CBC Seismic withstand all indoor and all outdoor equipment locations.
 2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
 3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance Test Seismic Qualification of proposed UPS equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) Seismic event motion, Certified and Approved by the AHJ.
 4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
 - a. 110MPH-West Coast States USA, California, and Hawaii, per ASCE/SEI 7-10.
 5. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be Certified, Signed and "Stamped" by PE Professional Engineer Licensed and in good standing in the State, Civil Engineer or Structural Engineer.

1.03 GENERAL

A. Description

1. Each Uninterruptible Power Supply (UPS) system shall provide online double conversion, continuous operation, solid state static, uninterruptible electric power supply and distribution. The UPS shall function as an active electrical power source, electrical power conditioning and active control system in conjunction with the following:
 - a. The facility normal (utility) incoming services electrical supply source or sources.
 - b. The Direct Current (DC) bus UPS input source.
 - c. The facility electrical loads connected to the UPS output

2. The UPS shall automatically provide continuity of electric power within specified tolerances to the UPS output loads, without interruption, including during failure or deterioration of the normal input power supply. Continuity of electric power to the load shall be maintained for an emergency time period with the UPS supplied by battery power up to the specified time and during restoration of the normal utility/ generator power supply.
 3. The UPS shall provide 100% continuous conditioned; uninterrupted electric power of the specified limited duration for any combination of linear and nonlinear UPS output loads shown connected to the UPS.
 4. Each UPS shall consist of a converter; DC input bus/charger and battery system; solid state inverters; maintenance bypass transfer circuit; controls and monitoring systems; synchronizing systems; circuit protective devices; operating software, and equipment enclosures.
 5. UPS Solid State Electronic Components
 - a. Digital-Signal-Processing using Pulse-Width-Modulation (PWM) of all UPS control and monitoring functions. Converter and inverter modules shall use Insulated-Gate Bipolar Transistors (IGBT).
 6. UPS shall be suitable and recommended by the Manufacturer for operation on normal utility electrical input power and/or standby engine generator supplied input electrical power.
 7. The UPS shall protect and correct the electrical supply to loads connected to the UPS resulting from electrical power failures, power sags, over voltages and power surges, frequency variations, brownouts, bidirectional electrical noise, bidirectional high voltage spikes/lightning, bidirectional switching transients, bidirectional harmonic distortion.
 8. UPS internal power supplies for UPS controls and fans shall be redundant “hot-swappable” without affecting or disrupting UPS output loads if one power supply fails or is removed for maintenance. Provide power supply failure alarm.
 9. UPS equipment shall all be the product of the same Manufacturer.
 - a. UPS units, limited to the following pursuant to direction from Owner. As manufactured by Eaton; or APC/Schneider Electric.
- B. Standards and Codes
1. The UPS shall be certified to conform, to be designed and to be manufactured to comply with the following Standards and Codes:
 - a. Underwriters Laboratory – UL 1778
 - b. Canadian Standards Association – CSA 22.2
 - c. International Electrotechnical Committee – IEC Semiconductor Converter Standards
 - d. International Organization for Standardization – ISO 9001
 - e. California Electrical Code – CEC
 - f. Federal Communications Commission – FCC Part 15 Subpart-J, Class-A for conducted and radiated noise
 - g. Institute of Electrical and Electronic Engineers – IEEE 587, Category A and B.
 - h. National Electrical Manufacturers Associates – NEMA PE-1
 - i. American National Standards Institute – ANSI 62.41

- j. EIA/TIA – 568B
- k. Local applicable Standards and Building Codes

PART 2 - PRODUCTS

2.01 DESCRIPTION AND OPERATION

- A. UPS System Operation
 - 1. The UPS shall operate continuously at described capacity and performances as a continuous on-line automatic system in the following modes to supply rated voltage and kVA output to the UPS connected loads.
 - 2. Modular configuration, providing incremental UPS electrical load and battery capacity expansion of the initial UPS capacity installation.
- B. Normal Mode
 - 1. The UPS inverters continuously supplies output to the loads connected to the UPS. Convert the UPS normal input voltage to regulated DC voltage for input to the inverter and simultaneously supply regulated DC as a float charge to the UPS D.C. bus storage batteries.
 - 2. If the DC bus/battery system is disconnected from the UPS for reasons of overload, failure or maintenance of the DC bus/battery system, the UPS shall continue to function and meet all of the specified performance characteristics, for the connected output loads, except the normal input source power outage back-up time capacity for the DC bus/batteries.
- C. Emergency Mode
 - a. Upon failure of the normal input power to the UPS, the inverter shall derive its input from the DC bus UPS battery system and provide continuous uninterruptible power to the loads connected to the UPS output. The transition from UPS normal input power to UPS DC bus battery system shall be accomplished without any switching or coupling and without any interrupting of power to the loads connected to the output of the UPS as a result of either a failure or restoration of the normal input source power to UPS.
- D. Recharge Mode
 - 1. Upon restoration of stable nominal normal input power to the UPS, the converter shall automatically reactivate and provide regulated DC voltage for input to the inverter and simultaneously supply regulated DC recharging of the DC bus UPS storage batteries. The recharge process shall occur automatically and without any interruption of the full load output to the loads connected to the UPS.
 - 2. Trickle charge to maintain battery recharge with a trickle charge and float charge to full 100% battery capacity. Provide equalizing voltage charge to batteries controlled by the UPS control system.
- E. Maintenance – Bypass Mode
 - 1. "Make before break internal bypass switch to provide bypass of normal input power around the UPS to the UPS output loads. The maintenance bypass shall provide electric isolation of the UPS from the UPS normal source input power, the D.C. input bus;

inverters/chargers; static switch; and the UPS output loads, without any interruption (make before break) of power to the UPS output loads.

2. The maintenance bypass system shall connect the UPS output loads to:
 - a. The same UPS normal input power source as the UPS
3. The maintenance bypass system shall automatically insure the bypass input source and load output are synchronized prior to permitting bypass mode operation.
4. The bypass system shall provide for a procedure to electrically and physically isolate the bypass system from the input sources, load output and UPS/inverters – chargers – batteries when the UPS is supplying the output load.

The isolation shall allow, without any interruption to the output load, inspecting, testing, repair, removal/reinstallation of the maintenance bypass system components, without any possibility of contact with the energized UPS/inverters – charger – batteries and output loads.

5. The UPS/inverters – charger – battery systems shall be electrically isolated and physically separated from the UPS maintenance bypass systems; the input sources; the load output, when the UPS is in the bypass modes. The isolation, without any interruption to the output load, shall allow inspecting, testing, repair, removal/reinstallation of the bypassed components of the UPS without any possibility of contact with the energized UPS maintenance bypass system components and output loads.

2.02 DEFINITIONS

- A. Uninterruptible Power System (UPS) - All components within the UPS module cabinet(s), separate battery cabinet(s), load output and bypass modules which function as a system to provide continuous, conditioned AC power to a load.
- B. UPS Module Cabinet - Metal enclosure(s) which contain the rectifier/charger, the inverter, the maintenance bypass switches, the external operator controls, and the internal control system required to provide specified AC power to a load.
- C. Battery Cabinet - Metal enclosure(s) which contain maintenance free sealed batteries sufficient to maintain UPS output according with the specifications and a battery disconnect circuit breaker.
- D. UPS Module - The rectifier/charger and inverter units which, under the supervision of the internal control system and external operator controls, provide specified AC power to a load.
- E. Rectifier/Charger - The UPS component which contains the equipment and controls necessary to convert input AC power to the regulated bus power required for battery charging and for supplying power to the inverter.
- F. Inverter - The UPS component that contains the equipment and controls necessary to convert DC bus power from the rectifier/charger or the battery to AC power required by the UPS connected output load.
- G. Internal Control System - The signal processing circuits which regulate the power conversion processes, detect fault conditions, and control the sequence of operation of the UPS. This term may be shortened to "control system".
- H. Operator Controls - The controls, which are used by the operator to monitor and operate the UPS.

- I. Maintenance Bypass – the automatic operation device that connects the UPS output load to the UPS input source when the UPS Module and Bypass cannot supply continuous power.
- J. Automatic Bypass Static Transfer Switch - The device, which connects the UPS output load to the static bypass line when the UPS Module cannot supply continuous power.
- K. Maintenance Bypass Line - The line, which connects electricity directly from the input power to the UPS connected output load during maintenance or whenever the UPS is not operational.
- L. Input Power Source - Power provided by the normal utility power source or auxiliary emergency standby engine generator source, which is connected to the input of the UPS.

2.03 ELECTRICAL PERFORMANCE CHARACTERISTICS

A. General

- 1. Grounding:
 - a. The UPS output load neutral shall be electrically isolated from the UPS input source neutral, when the UPS is operating in the normal mode.
 - b. The UPS shall be provided with equipment ground terminal bus and neutral terminal bus on each incoming source line side and load output side.
 - c. Provide for bonding the UPS load output system neutral bus and ground bus to the incoming source line side neutral bus and ground bus when the UPS is in the Bypass Modes.
- 2. The UPS shall comply with US Government Agency FCC – Class A RFI Requirements for all operating modes.
- 3. Input voltages, output voltages, kVA/kW output load rating and phase configurations as shown on the Drawings and specified herein.
- 4. UPS - Electrical voltage capacities
 - a. UPS normal input source lineside voltage 208/120-volt, 3 phase, 4 wire, 60Hz AC grounded.
 - b. UPS Maintenance-Bypass input source line side voltage, 208/120 volt - phase, 4 wire, 60Hz AC grounded.
 - c. UPS output load voltage 208/120 volt - 3 phase, 4 wire, 60Hz AC grounded.
 - d. Refer to Drawings for additional information.
- 5. UPS - Electrical load capacities
 - a. UPS initial output full load capacity as indicated on Drawings.
 - b. UPS modular full load output future expansion capacity up to additional 150%.
- 6. UPS - Electrical load operating DC bus battery capacity continuous time duration at full rated output load not less than 30-minutes.

B. UPS Normal Mode Input (Line Side Source) AC Sinewave, for Constant Rated Output

- 1. Voltage range tolerance without any DC bus battery discharge or transfer to Bypass Modes: $\pm 15\%$
- 2. 60HZ AC frequency range tolerance without any DC bus battery discharge or transfer to Bypass Modes: $\pm 5\%$

3. Reflected input power factor shall never exceed 1.0 (unity) when operating in the Normal Mode or Recharge Mode
 - a. At 100% load 0.92 lagging, minimum
 - b. At 50% load 0.85 lagging, minimum
 - c. When operating in the Bypass Modes the reflected power factor shall track UPS load power factor.
4. Maximum reflected Total Harmonic Distortion (THD) including UPS load contributions
 - a. At 100% load 7%
 - b. At 50% load 10%
 - c. When operating in the Bypass Modes the reflected THD shall track the UPS load THD.
5. Total UPS Efficiency when operating in any mode, including input/output isolation transformer losses:
 - a. At 100% load Greater than 92%
 - b. At 50% load Greater than 89%
 - c. UPS efficiency shall be the measured output KW divided by the measured input kW; with a connected load power factor of 0.8 lagging and the DC bus batteries fully charged operating on-trickle float charge.
6. Maximum magnetizing inrush current:
 - a. 1.0Hz maximum or less duration – six times normal full load input current
7. Input Source Load Limits
 - a. The UPS shall limit the total normal source input load of the UPS to a value not to exceed 130% of the UPS continuous output kVA full load rating.
 - b. The input source load limit value shall include the UPS DC battery recharging loads, DC battery trickle charging loads, UPS full steady state rated output loads and the UPS internal operating losses.

C. UPS Output (Load Side) AC Sinewave

The UPS shall comply with the load output electrical characteristics described below, when the UPS is operating in the Normal Mode, Emergency Mode or Recharge Mode. The UPS load output electrical characteristics shall track the UPS input source lineside when the UPS is operating in the Bypass Modes.

1. Dynamic voltage regulations, from 0kVA to full load rating, phase-to-phase or phase-to-neutral.
 - a. Balanced loads $\pm 0.5\%$
 - b. Unbalanced loads $\pm 2\%$
2. Maximum voltage transient response
 - a. 20% output load step $\pm 3\%$
 - b. 50% output load step $\pm 4\%$
 - c. 100% output load step $\pm 5\%$
 - d. Loss or return of AC input voltage $\pm 1\%$
3. Voltage transient recovery time of rated voltage to within 1%, less than 1.0Hz.

4. Voltage Total Harmonic Distortion (THD) not including connected load harmonic distortion contribution.
 - a. 100% linear load 2%
 - b. 100% non-linear load 5%
5. Overload capacity while maintaining voltage regulation within $\pm 2\%$ and while maintaining input source load limits.
 - a. 125% of full load output for 600 seconds.
 - b. 150% for 30 seconds.
 - c. 200% for 20 seconds.
 - d. 1000% for up to 1-Hz.
6. Manual voltage adjustment $\pm 5\%$
7. Frequency stability for all specified load conditions, DC bus voltage conditions and temperature conditions
 - a. Free running for all load conditions, DC bus voltage conditions and temperature conditions 60Hz $\pm 0.1\%$ in a 24 hour period $\pm 1\%$ in a 6 month period
 - b. Maximum slew rate 0.1HZ per second
8. Maximum Phase to Phase frequency Displacement (Imbalance)
 - a. Balanced loads 120 degrees ± 1 degree
 - b. 100% unbalanced loads 120 degrees ± 3 degrees
9. Connected load power factor 20% lagging to 130% leading for nominal UPS output/input operation.
10. Output synchronization:
 - a. The UPS output shall stay synchronized with the automatic bypass input source, if no automatic bypass system is present then maintain synchronization with the manual bypass input source line frequency, provided the static bypass input source line remains within the nominal frequency. Where a bypass is not required to be provided with the UPS, the UPS shall stay synchronized with normal input source.
 - b. If the input source line frequency goes outside described limits, the inverter shall break synchronization with the input source line and run on the UPS internal reference frequency. When the input source line frequency returns, within described limits, the inverter output shall automatically re-synchronize with the respective input source line.
 - c. The UPS shall be provided with a temperature compensated internal oscillator, to automatically maintain the output load voltage frequency when the input source line voltage frequency exceeds specified limits.
 - d. The rate of frequency change (slew rate) shall not exceed 0.1Hz per second.

D. Surge Protection Device and RFI/EMI Protection – (SPD)

The UPS shall comply with the surge protection device and RFI/EMI electrical characteristics described below, when the UPS is operating in the Normal Mode, Emergency Mode, Recharge Mode or Bypass Modes.

1. Lightning and Surge Protection Device, Electromagnetic Interference (EMI), and Radio Frequency Interference (RFI) Noise Filtering shall be provided for each UPS. The protection shall function during all UPS Operating Modes.
2. Provide EACH of the UPS source inputs and the load output of the UPS with lightning protection, surge protection device and EMI/RFI protection. The protection shall include functions for common mode and transverse mode; line-to-line (phase-to-phase); each line-to-ground (phase-to-ground); each line-to-neutral (phase-to-neutral) and neutral-to-ground connection protection configurations.
3. RFI and EMI
 - a. Conducted line noises interference both EMI and RFI shall be reduced by the UPS over a continuous spectrum of 0.5 MHz to 1.0 MHz.
 - b. The basis for reduction shall be a standardized 50 OHM insertion loss MIL –STD-220A Test.
 - c. Provide spectrum analysis test, dB attenuation reports showing EMI and RFI filtering over specified frequencies. Test data that is based on calculated or computer simulation is not acceptable.

4. Voltage surge protection:

- a. Phase-to-phase and grounded “WYE” Performance Requirements

Characteristics

1) Nominal line to line	<u>208/120 Volt</u> 208 Volt
2) Nominal line to neutral	120 Volt
3) Internal capacitance Microfarads	2.5
4) Maximum response time	1-nano second
5) Minimum EMI/RFI noise rejection	35-45 DB
6) Nominal peak clamp voltage line to neutral and line to ground	205 volts

- b. Minimum transient energy dissipation per phase (at 8x20 microseconds waveform): 1000 joules
- c. Peak transient withstand (at 8x20 micro-seconds wave-form) without failure of unit, ANSI C642.41: 50,000 amp
 - 1) Category-C3: 80,000 amp
 - 2) Category-B3: 60,000 amp
 - 3) Category-A3: 50,000 amp

E. UPS Short Circuit Withstand and Interrupt Ratings (bolted short circuit fault conditions, symmetrical and asymmetrical).

1. UPS line side input sources shall be “fully-rated” for the short circuit current available at the respective input sources of the UPS as described below, but in no case less than shown on the Drawings. “Series-Rated” with upstream devices is not acceptable for lineside input source devices:
 - a. 240 volts line-to-ground and below – 42,000 amp RMS symmetrical.

2. UPS internal components shall be “Fully-Rated” or “Series-Rated” to the UPS line side input sources and the UPS load side output, but in no case, less than indicated on the Drawings, and not less than indicated in the time-current short circuit study submittal.
 3. UPS load side output shall be “Fully Rated” or “Series-Rated” to the UPS line side input sources, but in no case less than indicated on the Drawings.
- F. UPS DC Bus (Battery Source)
1. Maximum D.C. ripple with or without batteries connected to the D.C. Bus
 - a. Voltage $\pm 0.4\%$
 - b. Current 2% RMS
 2. Battery voltage shall not vary beyond the following:
 - a. Mutual D.C. bus battery shall not exceed 550 volts
 3. The D.C. bus battery, end of discharge shutdown, shall be automatically adjusted by the UPS controls for partial UPS output load conditions, to allow for extended operation without damaging the batteries. Automatic shutdown based on discharge time is not acceptable.
 4. Battery recharge time from full discharge to 95% recharge shall not exceed 15-times the UPS full load Emergency Mode operating time duration, when the UPS Input Source Load Limit is set at 130%.
 5. An automatic battery equalize voltage charge shall initiate after the UPS returns to Normal Mode from any other operating mode. The override of equalize voltage and the time duration shall be adjustable from the UPS Control System.
 6. The D.C. bus battery “float” charging voltage shall be automatically temperature compensated for the battery ambient temperature as monitored by the UPS.
 - a. Approximate voltage adjustment range: ± 25 volt
 7. UPS Load Testing of D.C. Bus
 - a. Manually initiate from the UPS Control System a reduction of the D.C. bus battery charging voltage to approximately 1.9 volts per cell to force the D.C. bus batteries to carry the UPS load for a limited time.
 - b. If a drop in battery voltage occurs indicating diminished battery capacity or battery failure, shall automatically cancel the test and “Alarm” the UPS Control System.

2.04 ENVIRONMENTAL OPERATING CONDITIONS (INCLUDING BATTERIES)

- A. General
1. UPS equipment shall maintain a full UPS load and performance without any derating of UPS operation resulting from the ambient conditions described below.
- B. Ambient Conditions
1. Normal ambient operating conditions:
 - a. Temperature – 20 degrees to 30 degrees centigrade.
 - b. Humidity – 30% to 90% non-condensing.
 2. Emergency ambient operating conditions:
 - a. Temperature 0 degrees to 40 degrees centigrade.
 - b. Humidity 5% to 95% non-condensing.

3. Non-operating and storage conditions:
 - a. Temperature – Minus 20 degrees to positive 50 degrees centigrade.
 - b. Humidity – 0% to 95%
- C. Altitude Normal Conditions
 1. Operate from sea level to 5,000 feet above mean sea level without derating.
 2. Non-operating and storage from sea level to 25,000 feet above mean sea level.
 3. Installation location of the UPS exceeding 5000 feet above sea level. The UPS kW and kVA output load ratings and DC Bus battery capacities shall be increased to compensate for the UPS altitude derating recommended by the Manufacturer, to maintain the specified output load capacities of the UPS.
- D. Audible Noise
 1. Noise generated by the UPS under any condition of specified operation shall not exceed a sound pressure level measured at 5-feet from the nearest surface of the cabinet as follows:
 - a. Shall not exceed 65dBA.

2.05 UPS ELECTRICAL CIRCUIT PROTECTION, DEVICES AND DISCONNECTS

- A. Protection against External Events
 1. The UPS system shall incorporate built-in protection to prevent permanent damage to the UPS and to circuits extending external to the UPS for the following:
 - a. Overvoltage, under voltage and overcurrent surges introduced by the primary UPS input sources.
 - b. Overvoltage and overcurrent surges introduced on the UPS load output terminals by sources in the load, load switching and fault clearings in the distribution system of the load.
 - c. RFI and EMF
 - d. Transient voltage and lightning surges.
- B. Protection against Internal Events
 1. The UPS System (including the batteries) shall have built-in protection against permanent damage to itself and the connected load for all predictable types of failures within the UPS.
 2. Protective devices shall be provided for power semiconductors, these devices shall be configured to prevent cascading failures.
 3. The operation of any protective device shall be detected and displayed by the monitoring diagnostic system of the UPS Control System.
- C. Input and Load Output Circuit Protection Devices
 1. Device Types 100 amp and Greater Rating

Multipole gang operated; time overcurrent circuit breakers with field adjustable internal solid state trip protection units, providing long time overcurrent/delay, short time overcurrent/delay and instantaneous current, trip element adjustable settings and electrical “shunt-trip” operation. Auxiliary annunciator and pilot relay contacts to indicate when the respective device is “Open-Closed-or Tripped”.

2. Device Types under 100 amp Rating

Same as "100 amp or greater" Requirements or alternately multipole gang operated molded case circuit breakers with fixed non-adjustable thermal-magnetic overcurrent trip elements, adjustable instantaneous trip elements and electrical "shunt-trip" operation. Auxiliary pilot, relay contacts to indicate when the respective devices is "open-closed-or tripped".
 3. Protection devices shall be rated for true RMS voltage operation with loads containing 100% THD harmonic voltage content.
 4. Main circuit protection devices for UPS lineside input sources and for load side output shall be motor operated, to allow "on-off" switching control of the protection devices by the UPS Control System.
- D. Provide a main circuit protection/disconnect device on each line side input source to the UPS and on each load side output of the UPS. Each device shall be rated for the UPS respective circuit, continuous 100% load ampere input/output rating.
1. Main normal utility source input.
 2. DC bus battery input source.
 3. Each feeder/branch circuit load output.
 4. Maintenance bypass input source and load output.
- E. Output Load Branch Circuit Protection
- Provide individual branch circuit feeder load side output circuit protection devices for each load connection to the UPS shown on the Drawings. Each device shall be rated to supply the continuous 100% load ampere of the respective connected load without derating.
- F. Emergency Power-Off Controls (EPO)
1. The UPS shall be provided with the means of turning off the UPS and disconnecting power to all the UPS input source(s) and the output load both locally and remotely.
 - a. Locally - By a single operator switch.
 - b. Remote - By the opening of an external customer supplied normally open or normally closed pilot relay contact.
 2. Battery fused disconnect switches for manual on-off control of battery output, rated for battery disconnect ampere capacity.
 3. UPS equipment "emergency-shutdown" pushbutton key/switch to shut down and disconnect from the UPS all input sources, shut down and disconnect all output loads from the UPS and shut down the entire UPS system. Locate shut down on the UPS equipment.
 4. In addition to the UPS "emergency-shutdown" pushbutton located on the UPS, provide a remote UPS "emergency-shutdown" pushbutton for each UPS at each location shown on the Drawings, but in no case less than one remote pushbutton for each UPS, located at each door that provides access into the room occupied by the UPS.
- G. Over Temperature Protection
1. Provide internal temperature sensors to monitor temperature of critical UPS components. Upon detection of temperatures in excess of Component Manufacturer's

recommended ambient working temperature, the sensors shall cause audible and visual alarms to be indicated on the UPS Control Panel.

2.06 BATTERIES

A. Battery

1. Storage battery unit(s) shall be furnished for the UPS with sufficient capacity to maintain 100% full load operational characteristics and duration in a 25 degree centigrade ambient temperature as specified herein, plus not less than a 5% spare reserve capacity.
2. Battery cell caps shall incorporate hydrogen gas catalytic converter to reduce hydrogen out gassing during battery cycling.
3. The batteries shall be the maintenance free sealed type.
4. The battery containers shall be impact-resistant plastic. Each battery shall be designed for a 10-year life, when maintained under UPS full float charge operation as recommended by the Battery Manufacturer.
5. The batteries shall comply with and be tested per ANSI-N45.2 and MIL-I45208A.
6. The battery cell containers and covers shall be a flame-retardant material; all cells exceeding 0.25 kW per cell storage capacity shall include an integral flash arrestor.
7. The battery load circuit connection terminals shall be rated for the UPS D.C. bus, Recharge Mode, Normal Mode and Emergency Mode operating voltage and current.
8. Battery type:
 - a. The battery cells shall be lead-calcium type characteristics, VRLA type.

B. Battery Cabinet

1. All the cells making up the battery shall be installed in a freestanding cabinet, of the same construction as the UPS module cabinet. Battery shelves shall support and organize the batteries and D.C. wiring inside the battery cabinet. The cabinets shall all be of the same height and depth as the other UPS cabinets.
2. Each battery cell shall be held in place to prevent movement during seismic event, as required for Seismic Earthquake Restraints at the location of installation.

C. Battery Disconnect Circuit Breaker

1. Provide each UPS Unit with a DC-battery main circuit breaker. This circuit breaker shall be mounted between the battery output bus and UPS D.C. input bus. When the circuit breaker is open, there shall be no battery voltage present in the UPS module cabinet.
2. The UPS Module shall be automatically disconnected from the battery by opening a motor operated circuit breaker or contactor, when the battery reaches the minimum discharge voltage level or when signaled by other UPS Control Functions.
3. Disconnect shall be rated 600 volt D.C. operation, ampere rating equal to D.C. bus ampere rating and not less than 125% of the maximum DC Bus ampere flow.

D. All battery wiring shall be 600 volt insulated copper conductors.

2.07 CONTROL AND MONITORING

A. General

1. All of the operator controls and monitors shall be located on the front of the UPS Module cabinet.
2. Voltage, current, power, frequency and temperature parameters shall be measured and monitored using true RMS values, within $\pm 1\%$ accuracy.
3. Provide an annunciator lamp push-to-test button to test all annunciator lamps and audible alarms.

B. Controls

1. The startup, shutdown and bypass operations shall be accomplished by a single control switch that will indicate when and in what direction the control switch should be turned.
2. Pushbuttons shall be provided to display the status of the UPS. Pushbuttons shall also be provided to silence, test, set and reset visual and audio alarms.

C. Instrumentation for UPS Units

1. The following alphanumeric digital metering/monitoring information shall be monitored and displayed. A high value alarm, low value alarm and pre-alarm set points shall be field programmable for each metering/monitoring value and maintained in non-volatile UPS storage memory for recall display from memory. Analog to digital converters, current transformers and potential transformers for each instrumentation function shall be provided as part of the UPS system.
2. Each input source and the load output AC-voltage, AC-amperes and total harmonic distortion, line-to-line and line-to-neutral for each phase for:
 - a. UPS module.
 - b. Each UPS bypass unit.
3. Each input source and the load output-AC power factor, load capacity percentage; AC-frequency, AC-KW and AC kVA for:
 - a. UPS module.
 - b. Each UPS bypass unit.
4. DC battery bus:
 - a. Battery operating capacity and remaining capacity during battery operation.
 - b. Total UPS operating time of DC Bus source battery.
 - c. DC voltage and ampere.

D. Status and Alarms for UPS Units

1. The following alarms shall be displayed, an audible alarm shall activate when any of the following alarms occur. A visual alphanumeric display or pilot light annunciator shall display each condition. The time, date and duration for each status and alarm shall be maintained in non-volatile UPS storage memory, for recall display from memory. Analog to digital converters, sensors and transponders to sample and monitor each condition shall be provided as part of the UPS system.
2. Power-On, Power-Off and Power-Failed for each input source and load output (AC and DC sources).

3. DC bus
 - a. Battery discharging.
 - b. Low/high DC Bus voltage.
 - c. DC Bus ground fault.
 - d. Low battery reserve shutdown.
 - e. DC Bus batteries disconnected.
 4. UPS loss of synchronization.
 5. Temperatures
 - a. Equipment over temperature; pre-alarm shutdown.
 - b. Over temperature shutdown.
 - c. Cooling fan failure.
 - d. Battery over/under temperature.
 6. UPS Control Power failed.
 7. Each source input and load output:
 - a. Over, under voltage and loss of voltage.
 - b. Over and under frequency.
 - c. Overload warning and shutdown.
 8. UPS circuit breakers and circuit protection devices disconnect or fuse open.
 9. Rectifier/charger failure.
 10. Each UPS Bypass Mode:
 - a. Load operating on bypass.
 - b. Bypass input source not available/disconnected.
 - c. Bypass disabled.
 - d. Incorrect Bypass phase sequence.
 - e. Bypass input source and load output not synchronized.
 - f. Bypass disconnected from the load output.
- E. Mimic Panel
1. The mimic panel shall depict a single line diagram of the UPS. Indicating lights shall be integrated with the single line diagram to illustrate the status of the UPS Power paths. The functions whose status is to be displayed shall include, but not be limited to, the following:
 - a. Each input sources power available.
 - b. Output load power available.
 - c. Normal operation.
 - d. Bypass operation.

2.08 EQUIPMENT DETAILS

- A. All Materials and Parts comprising the UPS shall be new, of current Manufacturer, of a high grade and free from all defects and imperfections that may affect UPS correct operation and shall not have been verified in prior service, except as required during factory testing.

- B. All Active Electronic Devices shall be solid state. All semiconductor devices shall be hermetically sealed. All control relays shall be dust tight, visible contact position, “socketed” plug-in type.
- C. The Maximum Working Voltage, current and “di/dt” of all solid state power components and electronic devices shall not exceed 75% of the ratings established by the respective Manufacturer. The operating temperature of solid state component cases shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 90% of their voltage rating.
- D. Wiring
 - 1. Access holes with removable coverplates shall be provided on the top, bottom and sides of the UPS and battery cabinets for inter-cabinet wiring and customer installation wiring connections.
 - 2. All bolted connections of bus bars, lugs and cables shall be in accordance with Requirements of the National Electric Code and other applicable Standards. All electrical power connections shall be torqued to the required value and marked.
 - 3. Provide conductor connection lug landings for lineside input sources, load side output and control system conductor connections to the UPS. Quantity and sizes of conductor lug landings to match circuit conductors and ratings shown on the Drawings.
 - 4. All energized terminals and conductors landing/lugs shall be insulation shielded to ensure that Maintenance Personnel do not inadvertently come into contact with energized parts or terminals.
 - 5. Wire runs shall be protected in a manner, which separate and isolate power from control wiring. Provisions shall be made in the cabinets to permit installation of input, output, and inter-cabinet cabling, using raceway or conduits.
 - 6. Bus for AC line/load voltage current and bus for D.C. current shall be copper; maximum 800 amp per square inch current density based on 100% non-linear loading; continuous extruded insulation over bus with removable insulation “boots” at all screw/bolted bus connections. Bolted connections shall employ “spring-lock-washers”. Silver-plating of bus at all connection locations.
- E. UPS Cabinet Housing
 - 1. The UPS shall be contained in NEMA Type 1 metal enclosures, with key locking hinged metal access doors.
 - 2. Enclosures exceeding 400 pounds shall be anchored to the floor, held in place to prevent movement during seismic event, as required for Seismic Earthquake Restraints at the location of installation.
 - 3. The UPS housing shall be suitable for mounting on a concrete floor or carpeted floor.
 - 4. The UPS shall be structurally reinforced with provisions for hoisting, jacking and forklift handling.
 - 5. UPS cabinet housing segregation:
 - a. Provide separate cabinet(s) for each UPS modules, bypass modules and battery modules for UPS units.
 - 6. The UPS cabinets shall be cleaned, primed, and painted with the Manufacturer's standard colors.

7. Adequate forced air ventilation flowing through each UPS cabinet shall be provided to insure that all components are operated within their environmental ratings.
 - a. All ventilation fans shall be equipped with "wind- vane" sensors connected to an alarm annunciator on the UPS control system.
 - b. Provide removable replaceable air filters on air-cooling, air-intake vents on UPS units with internal cooling fans. Fans shall be redundant operation.

2.09 REMOTE ANNUNCIATOR PANEL

A. General

1. Provide a self-contained wall mounted remote annunciator panel to provide individual indication of the UPS Status and Alarm conditions.
2. The annunciator shall be alphanumeric display.
3. Provide pushbutton to silence the audio alarm with automatic resound.
4. Annunciator shall be flush or surface mount as indicated on the Drawings.

B. Status and Alarm Conditions

1. The remote annunciator shall display the same monitoring, status and alarm information for each UPS as the UPS Control System.
2. The remote annunciator panel shall provide remote control of the UPS from the annunciator panel with operator "password" authorization protection.

2.10 NETWORK COMMUNICATION

A. Communication Interface

1. The UPS shall communicate with the facility computer/data network. Provide Simple Network Management Protocol (SNMP) latest revisions and Management Information Base Protocol (MIBP) latest revisions. The UPS SNMP Agents shall comply with Internet Engineer Task Force IETF-RFC1628 basic and advanced levels standards, compliant software with multi-user site license. The software shall provide computer data network communication.
2. UPS internal network interface card shall provide compatible connection to the network installed at the computer data UPS connection location for "inband" network communication.
3. Provide "out-of-band" communication through RS-232 or USB modem port connection.
4. Communication ports shall be based on EIA/TIA – 568B Standard connections 100 BASE-T copper wire and multi-mode fiber optic communication links.

B. The Software shall operate on each network server and computer workstation node to provide the following monitoring and control functions:

1. Automatic unattended shut down of multiple network servers and multiple stand-alone systems, to prevent data loss after failure of the normal power source and prior to exhaustion of UPS battery storage capacity. Automatically save all data to hard disk drives.
2. Automatic reboot of equipment connected to the UPS power outputs, upon restoration of normal utility power.

3. Notification of normal power loss with broadcast messages to all network connected nodes.
 4. Automatic logging of power events to the network servers and workstations and UPS internal event storage memory.
 5. Software customizable network shut down and auto boot command sequences, with manager password protection.
 6. Provide an internal database of equipment connected to the UPS and provide variable delayed shut down duration of each connected unit.
- C. Install and Customize the UPS Software on the Network Servers' workstations, standalone equipment and UPS Equipment Control System.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation of the UPS shall be in full accordance with UPS Manufacturer's recommendations. Set and calibrate all adjustable settings as recommended by the UPS Manufacturer. Install and connect the UPS to the input sources and load output circuits.
- B. Transparent temporary protective plastic covers of suitable gauge shall be provided during installation of the UPS System to protect the entire UPS Equipment from dust and dirt at all times, except while working on a given module, after which the plastic covers shall be reinstalled. Remove temporary covers prior to placing UPS in operational service.
- C. Anchor the UPS Cabinet(s) to the building floor and walls and equipment racks as applicable to hold in place to prevent movement during seismic event, as required for Seismic Earthquake Restraints at the location of installation.
- D. UPS Communications
 1. Provide complete, copper wire computer data workstation outlet box, and outlet at each UPS location. Provide 0.75 inch conduit with two Category-6A, 4-pair STP twisted pair network data cables complying with EIA/TIA-568B, homerun to nearest computer/data network equipment rack patch panel, or computer data network terminal room closet from each UPS. Provide plug-in RJ-45 connection of UPS to computer data network outlet.
 2. Provide outlet box at each UPS and empty 0.75 inch conduit homerun to nearest telephone backboard from each UPS for voice telephone connection to UPS Controls.
 3. Provide outlet box at each UPS and two 1.25 inch conduit with conductors recommended by UPS Manufacturer, from UPS to each respective remote UPS Annunciator/Control Panel.
 4. Provide outlet box at each UPS and 0.75 inch conduit with 4#14 to each remote EPO.
 5. Install, set-up and test UPS Communications Network and Control Software.

3.02 TESTING AND COMMISSIONING

- A. General
 1. UPS equipment and batteries shall be inspected for damage as soon as they are received. Specifically check to see if wet cell batteries have been turned over in shipment and

whether the equipment cabinets have received any severe dents which might cause internal damage. Remove and replace all damaged equipment with new undamaged equipment.

2. Use only the factory provided knock-out areas and conduit entry provisions on the equipment for wiring. Care shall be taken not to let metal slugs or chips get into the equipment cabinet.
 3. Prior to energizing equipment, perform measurements on the incoming and load output AC lines to the equipment to insure that the proper voltage level is available and that there are no ground faults or high potentials between conductors or between phase conductor to neutral/ ground.
 4. Prior to installing the fuses, or closing the circuit breaker in the battery circuit, verify correct battery voltage, polarity markings, battery electrolyte level and all electrical connections are secure.
 5. Prior to turning the system on for any tests, the unit shall be bypassed with the mains connected to feed the load directly and the currents in each conductor measured and balanced. Follow Manufacturer's instructions for installation, connection and energizing equipment.
 6. Batteries which are shipped with the electrolyte in the battery cells shall be maintained on a float charger when not installed and energized, operating in the UPS Unit. Batteries shipped without electrolyte installed in the battery cells shall not have electrolyte added until equipment is installed and ready to be energized. Batteries which are not handled with this procedure will be rejected, shall not be used and shall be replaced with new batteries at the Contractors expense.
 7. Provide Factory Authorized Field Service Technician factory start-up to Inspect, Energize, Test and Certify the correct system installation, connections and operation. Provide written acceptance Field Service Report, six copies, to Owner's Representative.
- B. Provide Full UPS output load capacity and voltage capacity temporary inductive test load banks, 80% power factor and perform full load testing of the UPS after the installation is complete and prior to energizing the building system load circuits connected to the UPS. The UPS shall be cycled through two complete charges and discharge cycles with the UPS connected to the temporary load bank. Remove the temporary UPS load bank and complete UPS connections after the successful completion of the UPS Verification and of the UPS Compliance with the Contract Document Testing, Performance Requirements.
- C. Commissioning (Additional Requirements)
1. Setup, Testing, Startup, and Commissioning shall be performed by Factory Technician(s) Trained, Certified and Authorized by the Equipment Manufacturer. Final Commissioning shall be performed after installation and connections are complete.
 2. Provide system programming and setup of all control sequences for the UPS Operation and Control System.
 3. Simulate normal source power failure by opening (turn-off) building main service disconnect and verify connections and operation of each electrical system device connected to the system on both normal power source and emergency power sources.
 4. Record and document electrical demand load and sequence of operations on the UPS System with all connected loads operating.

5. Test all control system functions after the installation and connections are complete and the system has been energized. Verify each control sequence of operation and each device to be controlled are each operating correctly.
6. Record and document each device setup and program setting.
7. Submit written report (six copies) to Owner's Representative Certifying Commissioning has been performed; all respective systems are operating correctly and document all software setup and each device setting.

3.03 FACTORY SERVICE AGREEMENT (FIRST TWO YEARS OF OPERATION)

A. General

1. Provide site visits and written reports for each UPS at unit start-up, commissioning, and again approximately 12 months after completion of testing and commissioning and again 12-months from there. Shall be included as part of the Base Contract Scope.
2. Factory Authorized Technician shall visit site and startup-test all UPS Options, Accessories and Functions, Physical, Electrical and Mechanical Inspection. Simulate normal source power outage and recharge functions.
3. UPS factory remote monitoring and reporting of each UPS Status, using LAN-Network and/or telephone communications line provided by the Owner.
4. The Base Contract initial first-year-operation Service Scope shall be renewable, if mutual agreement between the UPS Manufacturer and the Owner is accomplished for service cost, scope and renew.
5. Provide three copies of Factory Service Proposal renew Agreement to the Owner's Representative.

END OF SECTION 26 33 53
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SECTION 26 50 00
LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SCOPE

A. Work Included:

All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General

1. Submit certification letter from Manufacturers of Lamps and Ballasts and Power/Driver Supplies, (or alternately, Manufacturer's published catalog data) stating/showing the specific lamp, ballast, or power/driver supply combination comply with Manufacturer recommendation and approval for the combined use, shown on the Drawings.
2. Provide complete Manufacturers catalog data information for each light fixture (luminaire), ballast, power/driver supplies, lamps, materials, auxiliary equipment/ devices, finishes and photometrics.

B. Performance Certification

1. Submit Manufacturer's Certified Test Report data showing compliance with Contract Document.
2. Submit Manufacturer's letter of certification for each fixture type, confirming the proposed combination of specific lamp, ballast, power/driver supply and auxiliary components for each light fixture (luminaire) type will function together correctly and perform in compliance with the Requirements of the Contract Documents as follows:
"The proposed drivers, (where, applicable), lamp sockets and fixture have been tested as an assembly. The proposed fixture products assemblies are certified by the Manufacturer to function within the required temperature, lumen output, electrical characteristics and operational life described in the Contract Documents".

C. Light Fixture Samples

1. If requested by the District's Representative, provide a sample of each fixture proposed as a substitution for a specified fixture. Sample fixture shall be complete with specified lamps, 3-wire grounding "SO" cord and plug for 120-volt 60Hz, AC plug-in operation. Sample fixtures shall be delivered to the District's Representative's Office for review, the samples shall be picked up within 10-working days after review comments have been received; any samples left beyond this time will be discarded by the District's

Representative. Decision of District's Representative regarding acceptability of any lighting fixture is final.

1.03 QUALITY ASSURANCE (ADDITIONAL REQUIREMENTS)

- A. Work and Materials shall be in full accordance with the latest Rules and Regulations as follows. The following publications shall be included in the Contract Document Requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the Requirements describing the more restrictive provisions shall become the applicable Contract definition:
1. UL – Underwriters' Laboratory:
 - a. UL – 8750 and 1598C: Light Emitting Diode – LED Equipment for use in Lighting Products and Replacements
 2. NEMA – National Electrical Manufacturers Association:
 - a. NEMA – LE4: Recessed Luminaires Ceiling Compatibility
 - b. NEMA – SSL #1, #3 and #6: Electronic Drivers for LED; LED and Incandescent Lamp Replacement
 - c. NEMA – LSD #44, #45, #49 and #51: SSL - Solid State Lighting
 3. United States Federal Government:
 - a. FCC – Part 18: EMI and RFI emissions limitations.
 - b. EPA: Energy conservation publications and waste disposal regulations.
 4. ETL and C.B.M. certified and approved.
 5. Electrical installation standards, National Electrical Contractors' Association:
 - a. NEIS/NECA and IESNA – 500: Recommended Practice for Installing Indoor Commercial Lighting Systems.
 - b. NEIS/NECA and IESNA – 501: Recommended Practice for Installing Exterior Lighting Systems
 - c. NEIS/NECA and IESNA - 502: Recommended Practice for Installing Industrial Lighting Systems.
 6. Illuminating Engineering Society – IES (IESNA):
 - a. IES – LM41: Photometric and Reporting.
 - b. IES – 587: Transient Surge Protection.
 - c. IES – LM79: Solid State Lighting (SSL) Testing and Measurement.
 - d. IES – LM80: Testing for Lifetime of LED.
 7. ANSI-American National Standards Institute:
 - a. ANSI – C81
 - b. ANSI – C82
 - c. ANSI – C62.41: Transient Withstand
 - d. ANSI – C78: Lamps
 8. State California Code of Regulations - Title-24: Energy Code

PART 2 - PRODUCTS

2.01 GENERAL

- A. Complete Fixture
 - 1. Provide light fixtures complete including lamps, drivers, housings, ceiling and wall trim "rings" for each ceiling type, mounting and adapter support brackets, diffusers/lenses and outlet boxes.
 - 2. Include an allowance of \$300.00 to provide a light fixture for each lighting fixture outlet shown on Drawings without a fixture type designation.
- B. Specific Fixture Requirements and Fixture Schedule Information
 - 1. The catalog numbers included in the description of the various types of lighting fixtures shall be considered to establish the type or class of the fixture with a particular Manufacturer only. The fixture length, number of lamps and lamp types, component materials, accessories, mounting type, ceiling, wall and install adapters, operation voltage, and all other components required to fulfill the total description of the fixture based on all Drawing information, Branch Circuits, Voltages, Specification information, and shall be included in the Contract Requirements regardless of whether or not the catalog number specifically includes these components.
 - 2. Lighting fixtures shall be the types as indicated in Fixture Schedule on the Drawings and as described in the Specifications.
 - 3. All fixtures of the same fixture type shall be the same Manufacturer and of identical finish and appearance, unless indicated otherwise on Drawings.
- C. Manufacturer Certification of Operation
 - 1. Lamps and lamp ballasts and power supplies (drivers) shall be recommended and certified by the respective Manufacturer(s), to be "matched" to operate correctly together, within the published characteristics, for efficacy, lamp starting, operating life hours, lumen output, power factor, power input, operating line ampere, sound intensity, and temperature.

2.02 POWER SUPPLIES (DRIVER-POWER SUPPLIES FOR LED-SOLID STATE LAMPS)

- A. General
 - 1. All ballast, power supplies, lighting fixtures assemblies and components shall be ANSI, ETL approved C.B.M. Certified and UL labeled.
 - 2. Ballasts shall comply with FCC Part 18 Class-A and NEMA limits as to EMI or RFI and not interferes with normal operation of electrical or electronic data processing equipment.
 - 3. Open circuit voltage, starting voltage, crest voltage and lamp-operating voltage shall comply with Requirements of the respective Manufacturer of the installed lamps.
 - 4. Lamp ballasts, power supplies and transformers shall be for use with the specific lamps provided as part of the Contract.
 - 5. Shall be suitable for use with automatic occupancy motion sensing type switching "on-off" control systems, with multiple "on-off" cycles per hour, on a 24-hours a day basis. Operation shall be without loss of performance in operating characteristics described in the Contract Documents.

6. Fusing
 - a. Shall be independently fused on the incoming line side within the fixture compartment.
 - b. Alternately the Ballast Manufacturer may install the equipment fuse inside the ballast/power supply.
 - c. Provide a label next to ballast cover reading: "Ballast (Power Supply) is fused, check fuse prior to relamping". Provide an additional quantity of 10% spare fuses and deliver to District's Representative.
7. Ballast sound rating Class-A or better. Where sound-rating classification is not published, the ballast sound rating shall be the best of product manufactured. Ballasts, which are judged by the District's Representative to be excessively noisy, shall be removed and replaced at the Contractor's expense with low noise ballasts.
8. Electronic solid-state ballasts and power supplies shall be the product of Manufacturer that has been producing electronic ballasts/power supplies for a minimum of 5-consecutive years prior to the date of the Contract.
9. Shall be designed and supplied to operate on the incoming line voltage system circuits to which the respective light fixtures are connected.
10. Shall not contain any PCB (polychlorinated biphenyl).
11. Power factor shall be not less than 0.90, starting and operating. The input starting transient line input ampere should never exceed lamp normal operating ampere by more than 10%.
12. Ballast and power supply disconnect:
 - a. Lighting Fixture Manufacturer factory installed and prewired inside each light fixture, for lamp-ballast or lamp-driver power supply.
 - b. Shall comply with UL-2459 and CEC/NEC. Shall disconnect (load-break) energized or de-energized ballast/driver from respective line voltage circuit and dimming circuit. UL-94V-0 flame retardant.
 - c. Hot pluggable, multi-pole, insulated connectors, with strain relief and finger-safe squeeze-to-release latching function.
 - d. Suitable for available voltage and ampere dimming and non-dimming lamp-ballasts and lamp-power supplies.
13. Ballast and power supplies as manufactured by General Electric, Advance, Philips, Universal, Sylvania/Osram or equal.

2.03 LIGHT FIXTURES (LUMINAIRES)

A. General

1. Lighting fixtures shall have all parts, ballasts, sockets, support attachments, trim flanges and fittings necessary to complete and properly install the fixture at the indicated installation locations. All fixtures shall be provided with lamps of size and type specified.
2. Ceiling and/or wall surface mounted lighting fixtures shall not have any exposed chase nipples or conduit knockouts visible to view within fixture housing. Lighting fixtures mounted in continuous rows shall have chase nipples or conduit knockouts between

lighting fixture housing, but shall not have visible chase nipples/conduit knockouts on the visible ends of the continuous row of lighting fixtures.

3. Where fixture color is indicated to be selected by the Architect and/or District's Representative, provide two color chip samples for each color for review.
4. Recessed fixtures with attached junction box shall be provided with a junction box permanently attached to the plaster ring so that the junction box is accessible through the fixture opening when the fixture is removed. Connection between fixture and pull box shall be flexible metal conduit with not less than 16 AWG "AF" or "CF" type fixture rated copper wires, high temperature wire insulation for not less than 600 volts AC. The flexible conduit shall be sufficient length, so that when the fixture is removed, the pull-box is readily accessible.
5. Recessed fixtures shall be Underwriters' Laboratory approved for recessed installation with plaster frame and attached pull box. Lamp enclosure, reflectors and finish wiring shall not be installed until plastering is completed. Exposed finish trim shall not be installed until finish painting of the adjacent surface is completed.
6. The fixture shall bear Underwriters' Laboratory label of approval for the wattage and installation indicated.
7. Light fixtures installed outdoors, in damp or wet locations shall be UL labeled for said location as "damp-location" and "wet-location" for the respective installation location.
8. Fixtures in contact with thermal/building insulation shall be UL listed and rated for direct contact installation in thermal insulation systems.
9. Lamp auxiliary support brackets shall be heat-resistant, non-dielectric. Alternatively, metal auxiliary lamp support brackets shall be electrically isolated from the fixture, to prevent glass decomposition.
10. Lighting fixtures installed in masonry and/or concrete construction. The fixture housing shall be rated for "concrete-pour" installation location.
11. Provide a permanent label inside each light fixture stating the following relamping information. Not less than 0.125-inch high black alphanumeric characters on white background.

"Replacement lamp(s) installed in this light fixture must comply with the following criteria:

*_: CRI _: Lamp Watts
 _: CCT-K _: Lamp Lumens*

Only lamp rated _ type lamp ballast shall be installed in this fixture."

**Insert the value required for the specific lamp required by the Contract Documents for each light fixture.*

B. Lens and Diffusers

1. Acrylic plastic or Plexiglas for the light fixture diffusers or fixture lenses shall be 100% virgin material.
2. Thickness of not less than 0.125-inch, as measured at the "THINIST" portion on the diffuser or lens. However, thickness shall be increased to sufficient construction and camber to prevent the lens and diffusers from having any noticeable sag over the entire normal life of the installation.

3. Diffusers shall be formed from cast sheet by a vacuum and/or pressure technique.
4. Lighting fixtures containing lamps with dichroic reflectors and light fixtures with non-dichroic lens/ diffuser shall be rated for high temperature lamp operations resulting from lamp heat redirected (reflected) back into the fixture.

2.04 SOLID STATE LIGHTING (SSL), LIGHT EMITTING DIODES (LED) LAMPS, POWER SUPPLIES, AND LIGHT FIXTURES (ADDITIONAL REQUIREMENTS)

A. General

1. Solid State LED light source (lamps), related control equipment (driver-power supply), and luminaire (light fixture) optics for light output distribution.
2. Shall comply with the US-DOE Energy Star Program for SSL-LED. Submit documentation with Shop Drawings.
3. Shall comply with the latest revision IESNA LM-79 and LM-80. Submit documentation with Shop Drawings.
4. SSL chromaticity shall comply with latest revision NEMA and ANSI – C78.377. Submit documentation with Shop Drawings.
5. Submit with Shop Drawings two samples of each light fixture type employing SSL, with prewired 120 volt, 60Hz AC “SO” cord and plug-in cap.

B. LED Lamps

1. Lamp lumen output and overall efficiency shall be based on the LED lamps installed in specified fixture and ambient operating temperature.
2. Lamp Color Rendition Index (CRI) shall equal or exceed CRI – 80, unless noted otherwise on Drawings.
3. Lamp color output shall be 4000-degree K ($\pm 100K$), unless noted otherwise on Drawings.
4. CRI and lamp color temperature shall be same for all light fixtures of the same fixture type.

C. LED Power Supply (Driver)

1. Combination of power supply and SSL – lamp shall be tested and certified by respective Manufacturers for performance and proper operation.
2. Provide dimming type driver where indicated on Drawings. Driver and dimming equipment shall be Tested and Certified by respective Manufacturers for performance and proper operation.

D. Self-Contained LED Lamp and Driver, Integral “Screw-Base” and/or “Pin-Connect”, replacement assembly for incandescent lamps.

1. Shall be dimmable. Dimmer and lamp shall be certified by respective Manufacturers for compatible correct operation with each other.
2. Optical system and operating temperature thermal performance shall be compatible with light fixture.
3. Comply with latest revisions of NEMA LSD-49 and SSL-6.

2.05 EMERGENCY BALLAST LIGHTING AND EMERGENCY DRIVER LIGHTING

A. General

1. Self-contained emergency ballast and power supply (driver) containing batteries, battery charger, solid-state electronic control and lamp/ballast/driver operation, contained within a metal case, red finish case color.
2. UL-924, listed Emergency Lighting and Power Equipment, for installation inside and/or attached to lighting fixtures.
3. The emergency battery supply unit(s) shall be provided inside each respective emergency light fixture by the Fixture Manufacturer.
4. Normal operating temperature range from 0-degrees Centigrade up to operating ambient temperature inside respective lighting fixture, but not less than 50-degrees Centigrade.
5. Provide a permanent label inside each emergency light fixture stating as follows, not less than 0.125-inch high black alphanumeric characters on a white background:
"Warning – this fixture provides more than one electric power source. Disconnect both normal and emergency sources including battery sources prior to opening fixture. Written permanent records documenting regular (every 30 days) emergency lighting function testing results shall be kept on file by the District."
6. UL and Manufacturer rated to supply the lamp and ballast/driver (power-supply) combination occurring in the respective light fixture, both dimming-type and non-dimming type light fixtures.
7. As manufactured by Bodine Inc. or IOTA-Engineering Inc.

B. Operation

1. Emergency mode
When external AC electrical power fails, the emergency unit shall immediately and automatically switch to emergency mode. Maintain emergency lamp(s) illumination, while operating from the internal battery/electronics during the power failure for not less than 90-minutes continuous duration.
2. Normal Mode
When AC electrical power is restored, automatically switch lamp(s) operation to external AC operation and begin battery-charging mode.
3. Battery Recharge Mode
The battery charger shall automatically fully recharge discharged batteries in less than 24-hours, and prevent overcharging of the batteries, while maintaining a "float-charge" on the batteries.
4. The emergency battery unit shall operate not less than two lamps in multi-lamp light fixtures and one lamp in single lamp light fixtures. When operating in emergency mode and battery power, the lamp lumen output of each lamp shall be not less than 40% of the lamp normal full lumen output rating of the lamp operation on normal power. The lamp-lumen output shall be 100% of the lamp normal full lumen output rating when operating in normal mode.

5. The emergency ballast shall provide cold-strike start and hot-restrike operation of the fixture lamp(s).
 6. Periodic automatic, internal self-test, simulating normal power loss and actual operation of emergency lamps on internal battery power. Auto self-test shall occur not more than 30-day intervals. Audible and visual trouble alarm display, with manual alarm reset/silence, for problems identified by auto-test functions.
- C. Electrical Characteristics
1. Emergency equipment shall operate on the same input AC voltage as the normally "hot" branch circuit supplying the respective light fixture. Maximum line input load shall not exceed 15% more than normal fixture electrical load.
 2. The emergency equipment shall be compatible for correct operation with the specific lamp/ballast/ driver combination contained in the respective light fixture.
 3. The emergency equipment shall be compatible with switched (on-off), non-switched (continuously on) and dimmer controlled lighting fixtures/circuits.
- D. Components
1. Sealed nickel cadmium batteries, maintenance-free, rated for continuous operation in high ambient temperature, with 7 to 10 year operational life expectancy.
 2. When standing on the floor below the fixture the emergency ballast test/monitor control panel shall be visible and readily accessible when the fixture is installed. The control panel shall provide:
 - a. Charging indicator visual annunciator to display the charger and battery status.
 - b. Momentary test switch/pushbutton to manually simulate power failure test.

PART 3 - EXECUTION

3.01 LIGHT FIXTURE INSTALLATION

- A. General
1. The Contractor shall verify actual ceiling and wall construction types as defined on the Architectural Drawings and furnish all lighting fixtures with the correct mounting devices, trim rings, brackets whether or not such variations are indicated by fixture catalog number. The Contractor shall verify depth of all recessed lighting fixtures with Architectural Drawings prior to ordering fixtures. Any discrepancies that would cause recessed lighting fixtures not to fit into ceiling shall be reported to the District's Representative prior to release of order to the Supplier of the fixtures.
 2. On acoustical tile ceilings, fixture outlets shall be accurately located in the center, at the intersection of the four corners or at the center of the joints of two tiles.
 3. The Contractor shall aim the exterior adjustable lighting fixtures after dark in the presence of, and at a time convenient to the District's Representative.
 4. Fixtures shall be ordered and furnished to operate correctly on the branch circuit voltage connected to the respective fixture as shown on the Site Plan and Floor Plan Electrical Drawings. The voltages shown on the fixture schedule are for generic fixture information only.

5. Install and connect lighting fixtures to the circuits and control sequences indicated on the Drawings and to comply with respective Manufacturer's instructions/recommendations.
 6. Lighting fixtures in building interstitial spaces, in mechanical plumbing and electrical spaces/rooms, are shown in their approximate locations. Do not install lighting outlets or light fixtures until the mechanical, plumbing and electrical equipment/pipes/ductwork are installed; then adjust and install lighting in revised clear (non-interfering) locations to provide best even-illumination. Coordinate the locations with all other trades prior to lighting installation.
- B. Lighting Fixtures Installed in Ceiling Support Grids – Suspended Lay-in "T-bar" and Concealed Spline Ceilings.
1. Provide two seismic clips at opposite ends of each recessed light fixture, the clip shall connect to the ceiling grid main runners and the light fixture. The light fixture with seismic clips and ceiling grid runner connections shall resist a horizontal seismic force equal to the total weight of the light fixture assembly.
 2. Each light fixture weighing 40-pounds or less and where the respective ceiling grid system is "heavy duty" type, shall be suspended directly from the ceiling grid or shall be suspended independent of the ceiling grid support system as approved by the AHJ. Each light fixture weighing more than 40-pounds or where the ceiling grid system is not a "heavy duty" type shall be supported independent of the ceiling grid and independent of ceiling grid support system.
 3. Each light fixture supported independent of the ceiling grid system shall be supported with a minimum of four taut independent support wires, one wire at each fixture corner.
 4. Each light fixture supported directly from the ceiling grid or ceiling grid support system shall be additionally connected with a minimum of two independent slack safety support wires. One wire at each opposite diagonal fixture corner. Each 3-feet by 3-feet and larger light fixture shall be supported in the same manner, except provide a minimum of four independent slack safety wires, one at each fixture corner.
 5. Light fixtures surface mounted to a suspended ceiling shall be installed with a 1½-inch steel – "C" channel which spans across and above a minimum of two parallel main ceiling grid "runners" and concealed above the ceiling. Each channel or angle member shall be provided with a minimum of two threaded studs for attaching to the fixture housing through the lay-in ceiling tile. Two steel "C" channel members shall be installed for each 4-foot (or smaller) fixture. Install the channels within 6-inches of each end of the light fixture to span a minimum of two ceiling grid parallel main runners. Provide two seismic clips connecting the ceiling grid main runners to each steel – "C" channel. Provide a not less than two taut independent support wires connecting to each channel. Bolt the light fixtures to the threaded studs on the channels or angles, to support the light fixture tight to the ceiling surface.
- C. Fixture Supports
1. The support wires for light fixture support shall be 12-gauge steel (minimum). The wires including their building and light fixture attachments shall provide support capacity of not less than four times the weight of the light fixture assembly. Provide additional light fixture support wires and building anchors to meet these Requirements, as part of the Contract. The support wires shall be anchored to the building structural elements above the ceiling.

2. Pendant mounting fixtures shall be supplied with swivel hangers. Fixtures shall swing in any direction a minimum of 45 degrees of gravity, position. Fixtures shall have special stem lengths to give the mounting height indicated on the Drawings. Stem to be single continuous piece without coupling, and to be finished the same color as the canopy and the fixture, unless otherwise noted. The Contractor shall check all lock nuts and set screws to rigidly secure the swivel socket to the stem, and the stem to the outlet box.

Fixtures shall be plumb and vertical. Where obstructions occur restricting 45-degrees free-swing of fixtures, the fixtures shall be "guy" wired to prevent fixtures from striking obstructions. The District's Representative shall approve method of guying. Swinging fixtures shall have an additional safety hanger cable attached to the structure and the fixture at each support, with the capacity of supporting four times the vertical weight of the light fixture assembly.
 3. Suspended fixtures weighing in excess of 40-pounds shall be supported independently of the fixture outlet box. Provide "air craft" (minimum 12 gauge) steel hanger cable for suspended fixtures route cable concealed or in pendant where possible. Each cable attachments shall support four times the weight of the fixture assembly. Securely attach the cable to the building structure.
 4. Surface mounted fixtures installed on drywall or plaster ceilings and weighing less than 40-pounds may be supported from outlet box. Provide structural supports above drywall or plaster ceilings for installation of fixtures weighing more than 40-pounds and secure fixture to structural supports. The use of toggle bolts is prohibited.
- C. Recessed Lighting Fixtures - Fire Rated Building Surfaces
1. Lighting fixtures recessed in ceiling or wall which has a fire resistive rating of 1-hour or more shall be enclosed in a fully enclosed backbox (except over fixture lens/diffuser). The material used to fabricate the "enclosed backbox" shall have a fire rating equal to that of the respective ceiling or wall.
 2. The space from the fixture to the box enclosure shall be a minimum of 3-inches.
 3. The backbox shall be concealed behind the fire rated ceiling and wall finish surface. The light fixture shall be provided with lamp ballast rated for (normal light output) operation in a "high" ambient temperature.

3.02 LENS AND DIFFUSERS

Lens, diffusers, internal reflectors shall be completely cleaned of all dust, dirt and fingerprints after the installation of the light fixtures and lamps, and after all trades have completed work and prior to occupancy of the facility by the District.

3.03 COMMISSIONING LIGHTING FIXTURES (ADDITIONAL REQUIREMENTS)

- A. General
1. Verify correct lighting control configurations and operation in each room.
 2. Simulate normal source power failure by "opening" (turn off) building main service disconnect and verify connections and operation of each emergency lighting fixture.
 3. Confirm "EXIT" sign directional arrows are visible in each "EXIT" sign.
 4. Verify light fixture support-hangers, ceiling grid clips and seismic restraints comply with the Contract Documents.

5. Remove protective shipping/installation shields on fixtures. Verify fixtures and lamps are clean and free of construction debris. Clean light fixtures found to be contaminated or dirty.
 6. Setup, program, and function test lighting control systems to perform each of the indicated control functions, area/room zones and sequences.
 7. Provide "aiming", directional adjustment of light fixtures, both indoor and outdoor. Aiming shall comply with Manufacturer's aiming diagrams, and as directed by District's Representative.
- B. Sample Spot-Check in each room the following lighting fixture information:
1. Lamp type and performance data.
 2. Ballast type and performance data.
 3. Combined Lamp/Ballast Certification of performance and compatibility by respective Manufacturer.
 4. Verify instructional signage is placed inside each lighting fixture in compliance with Contract Documents.

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SECTION 26 52 00
EMERGENCY LIGHTING CENTRAL BATTERY

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.
- B. Demonstration and Instruction (Additional Requirements)
 - 1. Provide on-site instruction classes and operation manuals to the District's Personnel.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. General
 - 1. Submit Manufacturer product data, dimensional data, ambient environmental data and derating factors, electrical performance data.
 - 2. Submit performance and technical information on battery calculations and/or factory tests demonstrating capacity capabilities.

1.03 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

- A. General
 - 1. The equipment shall be listed, labeled and approved for the application show in the Contract Documents, as a battery stored energy, emergency lighting electrical power inverter, complying with the most recent version of the following applicable Standards.
 - 2. The following Standards shall become Requirements of Contract Document and are included in the Contract Documents.
- B. Underwriters Laboratory - UL
 - 1. UL – 924 and 924A Standard for Emergency Lighting and Power Equipment.
 - 2. UL – 1778 Standard for Uninterruptible Power Supply Equipment.
- C. National Fire Protection Agency - NFPA
 - 1. NFPA – 111 Stored Electrical Energy and Standby Power systems.
 - 2. NFPA –70 Article 700 Emergency Systems. (NEC) Article 480 Storage Batteries.
- D. Federal Communications Commission - FCC
 - 1. FCC – Class A RFI emission limits.
- E. American National Standards Institute – ANSI
 - 1. ANSI – C62.41 Both Category-A and Category-B and C62.45 Transient Voltage Withstand.

- F. Institute of Electrical and Electronic Engineers-IEEE
 - 1. IEEE – 587 Surge Voltages
- G. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements).
 - 1. The complete emergency lighting central battery inverter assembly; including circuit protection devices, meter, housings/enclosures, batteries, accessories, supports/anchors etc., shall be designed, manufactured, and tested.
 - a. Wind loading all outdoor equipment locations.
 - b. Earthquake Seismic Requirements of CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
 - 2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
 - 3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance test seismic qualification of proposed equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
 - 4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
 - a. 110MPH-West coast states USA, California, and Hawaii per ASCE/SEI 7-10.
 - 5. Seismic test shall be performed by a third party independent test laboratory, shall include batteries. Wind Analysis and Seismic Testing and reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.
- H. Short Circuit, Coordination and Arc-Flash (Additional Requirements)
 - 1. Perform and submit short circuit fault current, time/current coordination and Arc-Flash fault engineering analysis, for AC and DC circuits.
 - 2. Provide label equipment with warning and instructional signs.

PART 2 - PRODUCTS

2.01 OPERATION

A GENERAL

- 1. The Emergency Lighting Battery Unit (ELBU) shall be self-contained, automatic operation. Unit shall store electrical energy and supply standby back-up electrical energy upon failure of normal (utility source) power and provide operation of lighting and other connected equipment as described in the Contract Documents.
- 2. ELBU shall consist of an automatic circuit transfer system, input/output circuits, storage batteries, battery charger, voltage inverters, monitoring, test/monitoring equipment and operating program software. Manufactured with all components enclosed in modular cabinetry.

3. ELBU volt-ampere continuous load rating shall be sufficient to provide operation of the full unit rated load. But in no case less, than required to supply all of the connected loads shown on the Drawings, plus an additional 20% spare continuous load capacity "Safety-Factor". All at an 80% (0.80) lagging load power factor.
 - a. Normal mode load capacity operation duration shall be continuous.
 - b. Emergency mode full 100% rated load capacity operation shall be for the duration time indicated on the Drawings, but not less than 90 continuous minutes.
4. Unit shall operate properly in ambient temperatures from 15 to 25 degrees centigrade, sea level to 10,000 feet above sea level, at the specified ratings.
5. Emergency lighting central battery unit shall be as manufactured by Dual-Lite; or Myers Power Products.

B. Operation

1. During operation under normal mode 60Hz AC power, the supply voltage shall feed both the output load and the battery charger. Upon normal power failure, the output load shall be automatically transferred to internal 60Hz AC emergency mode power operation.
2. When normal power is re-established, the output load shall be automatically transferred back to the normal power AC line and the charger shall commence recharging the batteries to their full capacity.
3. Transfer to emergency mode operation shall occur when normal input voltage drops to less than 60% to 70% of nominal for brownout protection on any input line phase. The transfer to emergency mode shall also occur if there is an open circuit, or shorted circuit on the normal input side. A 15 to 60-second transfer time delay (nominal) back to normal mode operation shall be adjustable to reduce "cycling" operation between normal and emergency operating modes.

2.02 LOAD REQUIREMENTS

A. Load Types

1. Load output shall be provided for the following types of loads in any loading combination (0 to 100% of load rating), within the rated capacity (0 to 100% of load rating) for 50% (0.5) lag through 50% (1.5) lead load power factors.
2. Unit shall be suitable for operation and withstand inrush currents associated with the connected loads without damage or changes in its operation including:
 - a. Incandescent lamps and ballasts.
 - b. Fluorescent lighting fixtures and ballasts.
 - c. Electronic equipment including fire alarm equipment.
 - d. High Intensity Discharge (H.I.D.) lighting fixtures and ballasts (continuous ARC-sustain operation).
 - e. Solid state electronic lighting fixture ballasts and dimmers.
 - f. Electromagnetic lighting fixture ballasts and dimmers.
 - g. LED (Light Emitting Diode) solid-state lamps and drivers.
 - h. Fire door holds open devices.

B. Voltage

1. Normal power input and output voltage shall be 60Hz, AC single phase or three phase; 120 volt; 208 volt; 240 volt; 277 volt; 120/208 volt 3 wire or 120/240 volt 3 wire. All as indicated on the Drawings.
2. Provide multiple load output voltages, for both normally on and normally off loads, where indicated on the Drawings (i.e., 120-volt input - 120 volt and 277-volt load output; 277 volt input-120 volt and 277 volt output; etc.).
3. The total line input volt-amperes shall not exceed 135% of the unit rated full load output volt amperes and output line voltage, including battery-recharging loads.

C. Circuit Breakers Line and Load

1. Provide load output circuit breakers, ampacity and quantity as indicated on the Drawings, but in no case less than one 20-amp load output circuit breaker for each 1500 volt ampere (or portion thereof) of unit rated load capacity. Provide the circuit breakers on each normally off and each normally on load out connection and on each load out voltage connection.
2. Provide a unit main line input circuit breaker in the ELBU. The circuit breaker shall be sized to allow continuous full rated load operation of the ELBU, including battery-recharging loads.
3. Provide D.C. battery protection internal breakers.
4. The circuit breakers shall be thermal magnetic molded case type. The Main line input circuit breaker shall be rated a minimum of 42,000-amp symmetrical short circuit interrupting capacity, but not less than shown on the Drawings. Internal and load output circuit breakers shall be "series rated" or "fully rated" to the main input circuit breaker symmetrical short circuit interrupting capacity, at the specified input and output voltage(s).
5. Monitor and trouble-alarm each circuit breaker for "tripped" or "off" condition.

D. Load Output

1. Provide output load types as follows (in any combinations up to unit full rated output capacity).
2. Normally on - Output load is energized in both the normal and emergency modes.
3. Normally off - Output load is energized only when unit is in the emergency mode and de-energized when the unit is in the normal mode.
4. The unit shall function correctly with no load (zero-volt amp) connected to the output terminals. UNITS REQUIRING A MINIMUM CONNECT LOAD FOR CORRECT OPERATION ARE NOT ACCEPTABLE.

E. Load Output Voltage Characteristics

1. During the entire rated operation duration, output voltage shall be sinusoidal wave.
 - a. Total harmonic distortion shall not exceed 5% under any combination of the specified load conditions.
 - b. Voltage Regulation shall not vary more than plus or minus 5% of rated voltage under all load conditions, no load 0% to 100% of full rated load.

2. Load output voltage frequency regulation shall be within plus or minus 0.5Hz under specified load conditions, when operating on the inverter and batteries.
- F. Efficiency When Operating In Any Mode
1. At 100% rated load – greater than 97%.
 2. At 50% rated load – greater than 94%.
 3. Efficiency shall be measured load output kW divided by the measured line input kW; with a connected load power factor of 0.8 lagging and the batteries fully charged operating on trickle float charge.
- G. Internal Bypass Switch
1. Switch shall keep all of the loads circuits energized while the ELBU is shut down (bypass) due to malfunction or maintenance.
 2. Three position switch: normal; unit bypass; loads off.

2.03 INVERTERS

- A. General
1. Inverters shall be modular and completely solid state. Protected against overloads, in rush loads and short circuits.
 2. Inverter shall provide stable regulated output operation from the internal batteries under all specified load conditions.
 3. Low battery voltage cutout shall be provided to disconnect the inverter load when the battery output voltage drops below a preset value.
 4. Automatic unit restart after initiation and/or restoration of normal input power.

2.04 CONTROL, TESTING AND MONITORING EQUIPMENT

- A. Internal control, monitoring and testing with programming software and microprocessor control operation shall be provided to verify proper system operation and trouble conditions. Control, testing, and metering display panel shall be installed in the door of equipment cabinet not more than 6-feet-0-inches above finished floor.
- B. System Display/Control Panel
1. The system's display panel shall include an array of visual indicators, multi-line alphanumeric character display, and a keypad to control and monitor the system.
 2. The array of visual indicators shall monitor and annunciate the AC utility presence, system ready status, battery charging status, battery emergency operation, and alarm functions.
 3. The system shall display alphanumeric meter functions including:
 - a. Input-voltage and input demand load.
 - b. Output-voltage, output-frequency, output-demand load and output-power factor.
 - c. Unit internal component temperatures.
 - d. Total quantity of power outages and inverter operating time.
 4. To ensure only authorized personnel can operate the unit, the system shall be password protected for all control functions, including parametric changes.

C. Alarms

1. The system shall have audible and alphanumeric visual alarm display, with automatic logging of the twenty most recent alarm events. Each alarm will have a corresponding audible signal associated with it to aid in the troubleshooting of the system.
2. The system's alarm acknowledge feature shall enable the user to silence only the current audible alarm(s), while not silencing other alarms and not clearing the alarming condition until the fault has been cleared.
3. Alarms shall monitor low, near low, and high battery voltage; high AC voltage input; high and low AC voltage output; volt-amp output overload; low runtime remaining; high ambient component temperature over limit; check charger, battery, inverter, and memory/logic; emergency power off activated; user test check; and call service.
4. Alarms on each internal circuit breaker, to indicate when the circuit breaker is in the open/off/tripped positions.

D. Manual and Programmable Testing

1. The system shall provide both manual test functions and software programmable automatic test modes. The user shall be able to perform a system test at any time.
2. The system shall also perform an automatic programmable, weekly, self-diagnostic test and load test of its subsystems to insure the system will operate in an emergency condition. A monthly load test for a user programmable discharge time and an annual test for a complete runtime discharge time and an annual test for a complete runtime discharge.
3. Automatic recording in memory, of the last twenty inverter events, including all automatic weekly and user programmed tests, shall be logged.

E. Remote Terminal Strip

1. An auxiliary terminal strip located within the system cabinet shall provide connection points for remote monitoring of inverter status and alarm indication.
2. Remote monitor/annunciator panel:
 - a. Provide a remotely mounted ELBU monitoring/alarm panel, with operating status and alarm conditions visual and audible indicators. Provide an audible alarm silence push-button with automatic resound on subsequent alarms.
 - b. The panel shall be enclosed in a Nema 1 for indoor locations, NEMA 3R for outdoor locations. Flush mounted housing, with "see-thru" front cover access door. Tamper resistant construction, suitable for installation in unsupervised public areas.
 - c. The remote monitoring and alarm panel shall operate over connecting circuit lengths up to not less than 300-foot distance from the respective ELBU.
 - d. Provide remote monitoring and alarm panels adjacent to each fire alarm annunciator panel unless noted otherwise on the Drawings.

2.05 BATTERIES

A. General

1. Batteries shall provide capacity to operate the unit and maintain specified inverter output for indicated years on a pro-rata basis when properly maintained as recommended by the Manufacturer.

2. Flame arresting caps shall be provided on batteries, with catalytic conversion to prevent hydrogen out gassing.
 3. Battery cases shall be translucent to allow visual observation of electrolyte level. Provide earthquake restraint battery mounting straps.
- B. Battery Seismic Restraint
1. Batteries shall be installed in the unit with seismic restraint anchors and straps.
- C. Battery Type
1. Batteries shall be nickel cadmium low maintenance type to reduce the need to replenish battery fluids. Batteries shall be 25-year design life expectancy at 77-degrees Fahrenheit ambient, pocket plate construction. Maximum battery discharge shall be automatically limited to the value recommended by Battery Manufacturer of nominal battery voltage, with full rated unit output during discharge.

2.06 BATTERY CHARGER

- A. General
1. Battery charger shall be solid state specifically designed for the type of batteries used in the system.
 2. Battery charger shall have automatic protection against short circuits, low battery condition, DC-over voltage protection and protected against thermal runaway.
 3. Charger shall automatically maintain correct battery charge conditions, with float charging and periodic equalize battery charges, within plus or minus 0.05 volts of Battery Manufacturer's recommendations.
 4. The charger shall completely restore fully discharged batteries from the input line source, to full battery charge condition in less than 24 hours.

2.07 CABINET

- A. General
1. The cabinetry shall contain all components, inverter, transformers, power supplies, battery charger, including the batteries, free standing with hinged locking door. All components shall be accessible from the front for maintenance and removal.
 2. Units requiring side access for cooling air or maintenance shall not be acceptable unless the Drawings specifically show the permitted side access space provisions.
 3. Provide water shields on cabinets, to protect the ELBU from fire sprinkler discharge water damage.
- B. Cabinet Construction
1. The cabinets shall be metal, NEMA 1 enclosure, equipped with a key-operated access lock.
 2. Manufacturer's standard finish color with rust inhibitor "primer" and acid-resistant finish paint.
 3. Battery shelves shall permit the batteries to be tested or have battery fluids added without having to remove the batteries.

4. The doors shall open full without affecting the operation of the unit. Conduit knockouts shall be provided on both sides, bottom and top of the cabinet for connection of line and load circuits. Provide dead front or insulated covers over exposed energized parts to prevent accidental contact, when doors are open.
- C. Electrical Connections
1. Provide line and load terminal lugs and identification tags on all circuits.
- D. Size
1. Maximum cabinet size including batteries shall not exceed those shown on Drawing, but in no case larger than as follows:
 - a. Up to 4600VA at 80% power factor rated load output: 43-inches wide by 84-inches high by 21-inches deep.
 - b. 4601VA to 11000VA at 80% power factor rated load output: 85-inches wide, by 84-inches high by 24-inches deep.
 - c. 11001VA to 17,500VA at 80% power factor rated load output: 128-inches wide by 84-inches high by 26-inches deep.

2.08 COMMUNICATION PORTS

- A. General
1. The ELBU shall provide a standard RS-232 bi-directional serial communications port, for communicating with portable computers. Provide software with the ELBU for control, monitoring and diagnostic/maintenance operations of the ELBU. The software shall operate on Microsoft-Windows® based, PC style computers, using 3.5-inches “floppy-disk” magnetic storage media, or 5.25-inch “CD/DVD” ROM.
 2. The PC computer is not included in the contract scope of work.
- B. Remote Monitoring and Control
1. Facsimile/Modem Communications Panel: Shall automatically transmit system’s operating status reports over a dedicated “dial-up” telephone line to remote locations. Provide 1-inch conduit with (ANSI/EIA/TIA-568B) two Category-6, 4-pair, UTP cables and homerun to IDF/MDF telephone terminal.
 2. Each designated location shall automatically receive a unit status reports transmission following all monthly and annual test cycles or when an alarm conditions is detected by the system’s self-diagnostic electronics.
 3. Status reports shall be software programmable and include readings on key operating parameters as well as complete alarm and inverter log printouts.
 4. The ELBU Manufacturer shall provide 364 calendar days duration, remote monitoring and supervision of each ELBU. The start date shall begin from the Construction Contract substantial completion date, notice of completion. Provide not less than two written status reports, to the District’s Representative, at 180 calendar days and 330 calendar day milestones.
 5. The District and Manufacturer shall have the option to renew the Manufacturer’s Monitoring Control Contract at a negotiated fair market price and terms, at the end of the initial 364 calendar day periods.

C. Monitoring and Communications Circuits

1. Provide monitoring and communication circuits as follows:
 - a. One 0.75-inch conduit, homerun from each ELBU to nearest telephone/data terminal backboard, with two EIA/TIA-568C Category-6A 4-pair UTP communication cables in conduit.
 - b. One 0.75-inch conduit, homerun from each ELBU to Building Automation System (BAS) communications transponder, with two EIA/TIA-568C Category-6A, 4-pair UTP communications cables in conduit.

PART 3 - EXECUTION

3.01 TESTING

A. General

1. All units and batteries shall be inspected for damage as soon as they are received. Specifically check to see if wet cell batteries have been turned over in shipment and whether the equipment cabinets have received any severe dents which might cause internal damage. Remove and replace all damaged equipment with new undamaged equipment.
2. Use only the factory provided knock-out areas and conduit entry provisions on the equipment for wiring. Care shall be taken not to let metal slugs or chips get into the equipment cabinet.
3. Prior to energizing equipment, perform measurements on the incoming and load output AC lines to the equipment to insure that the proper voltage level is available and that there are no ground faults or high potentials between conductors or between phase conductor to neutral/ground.
4. Prior to installing the fuses, or closing the circuit breaker in the battery circuit, verify correct battery voltage, polarity markings, battery electrolyte level and all electrical connections are secure.
5. Prior to turning the system on for any tests, the unit shall be bypassed with the mains connected to feed the load directly and the currents in each conductor measured and balanced. Follow Manufacturer's instructions for installation, connection and energizing equipment.
6. Batteries which are shipped with the electrolyte in the battery cells shall be maintained on a float charger when not installed and energized, operating the emergency power unit. Batteries shipped without electrolyte installed in the battery cells shall not have electrolyte added until equipment is installed and ready to be energized. Batteries which are not handled with this procedure will be rejected, shall not be used and shall be replaced with new batteries at the Contractors expense.
7. Provide factory authorized Field Service Technician factory start-up to inspect, energize, test and certify the correct system installation, connections and operation. Provide written acceptance field service report, six copies, to District's Representative.

B. Commissioning (Additional Requirements)

1. Setup, testing, startup, and Commissioning shall be performed by factory Technician(s) trained, certified and authorized by the Equipment Manufacturer. Final Commissioning shall be performed after installation and connections are complete.
2. Provide system programming and setup of all control sequences for the emergency/exit lighting control system.
3. Simulate normal source power failure by opening (turn-off) building main service disconnect and verify connections and operation of each electrical system device connected to the system on both normal power source and emergency power sources. Simulated test time for operating duration connected on the emergency systems shall be not less than 90 continuous minutes without failure or anomalies in the system.
4. Record and document electrical demand load and sequence of operations on the ELBU system with all connected loads operating, including but not limited to:
 - a. Fire alarms
 - b. Egress/exit lighting
 - c. Doors
 - d. auto-loading and overload shedding controls
5. Test all control system functions after the installation and connections are complete and the system has been energized. Verify each control sequence of operation and each device to be controlled are each operating correctly.
6. Record and document each device setup and program setting.
7. Submit written report (six copies) to District's Representative certifying Commissioning has been performed; all respective systems are operating correctly and document all software setup and each device setting.
8. Refer to Commissioning Section 01 81 00 for Additional Requirements.

3.02 SEISMIC EARTHQUAKE

A. General

1. The entire unit shall be installed and anchored to building structure to comply with Seismic Earthquake Requirements.
2. Install Seismic Restraints on all batteries.

3.03 FACTORY SERVICE AGREEMENT (FIRST YEAR OPERATION)

A. General

1. Provide site visits and written reports for each ELUB at unit start-up, Commissioning, and again approximately 12 months after completion of Testing and Commissioning. Shall be included as part of the base contract scope.
2. Factory authorized Technician shall test all ELUB options, accessories and functions, physical, electrical and mechanical inspection. Simulate normal source power outage and recharge functions.
3. ELUB factory remote monitoring and reporting of each ELUB status, using telephone communications line provided by the District.

4. The Base Contract initial first year operation service scope shall be renewable, if mutual agreement between the ELUB Manufacturer and the District is accomplished for service cost, scope and renew.
5. Provide three copies of factory service proposal renew agreement to the District's Representative.

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SECTION 27 05 36
CABLE TRAY FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit Product Data Sheets for all cable trays, all related components, and NEMA VE1.
- B. Submit Cable Tray Support Details.
- C. Provide Reproducible Floor Plan Shop Drawings, with the same scale as the Contract Floor Plan Drawings. The Drawings shall show the proposed Cable Tray Layout Plan views. An elevation view shall be provided at each riser or change in horizontal elevation in the cable tray. The Shop Drawing Plans shall show all building elements, expansion/seismic joints, air ducts, piping and components that cross the path of the cable tray, along with separation of the cable tray from the crossing components.

PART 2 - PRODUCTS

2.01 CABLE TRAY

- A. Material and installation shall comply with NEMA - "VE1" latest edition, Cable Tray Systems', N.E.C., California Title 24 and Title 8. As manufactured by Globe Tray, Chalfant, P-W Industries or equal.
- B. Cable tray shall include two longitudinal side rails, ladder type, with transverse 6 inches rung spacing welded to side rails. Rungs shall have a minimum cable-bearing surface of 0.75-inches. Rungs shall not extend below bottom of side rails. Splice plates shall be locking bolt type to connect tray sections together without decreased tray strength. Provide expansion/deflection fitting at each building seismic and expansion joint crossing.
- C. Trays shall be steel or aluminum. Steel trays shall be hot dip galvanized after fabrication ASTM A 123 with ANSI type 304 and 316 stainless steel hardware. Aluminum trays shall be extruded from 6063-T6-aluminum alloy with 5052-H32-aluminum alloy hardware.

- D. The complete cable tray system and supports shall be designed for the following minimum uniformly distributed working load but not less than indicated on the Drawings, with a 1.5 minimum safety factor, when supported as a single span. In addition, the cable tray shall support 200 pounds concentrated at span midpoint without permanent distortion.
 - 1. Cable tray wider than 12-inches or deeper than 6 inches, live loading 200 pounds per linear foot.
 - 2. Cable tray 12-inches or less in width and 6 inches or less in depth live loading 100 pounds per linear foot.
- E. Provide ladder type "elbows", "tees", horizontal "crosses", expansion connectors, reducer sections, connectors, straight sections, curved sections, fittings, supports, hangers, blind ends, risers and accessories to provide a complete installation of the cable tray shown on the Drawings. Provide trapeze brackets and individual threaded hanger suspension rods in any combination required to support the cable tray system. Provide all materials and labor necessary for a complete installation.
- F. Cable tray runs shall be minimum 6-inches deep by 12-inches wide, but not less than indicated on Drawings. Dimensions are outside dimensions of the cable tray rails.
- G. Similar cable tray parts and hardware shall be interchangeable with each other. The cable tray system shall be free of sharp edges, burrs or projections that can damage cable insulation.

PART 3 - EXECUTION

3.01 CABLE TRAY

- A. Cable trays shall be seismically anchored and supported to the building structure to prevent horizontal or lateral movement with 1.0-gravity acceleration, including specified live load conductor capacity, complying with State of California Seismic Codes. Support hangers from the building structure shall provide a 2.0 weight carrying safety factory including specified live cable weight. Cable tray hangers shall be provided with a spacing to insure the maximum cable tray deflection with the specified live cable loading does not exceed 0.75-inches between supports and hangers. In no case shall cable tray support or hanger spacing be greater than 12-feet on center.
- B. Punching or drilling of structural side members shall not be performed except for splice plate bolt-holes.
- C. Provide expansion adapters where cable trays cross a building expansion joint, and to comply with Tray Manufacturer's recommendation for the Cable Tray Thermal Expansion Requirements.
- D. All cable trays including non-connected tray sections shall be made electrically continuous. Provide grounding jumpers minimum equivalent to #8AWG, where required to provide continuity.
- E. Grounding for cable trays shall comply with Article 318-6 of NEC.
- F. Provide curved "radius" cable trays at each "horizontal" or "vertical" change in direction of the cable tray. Provide "tee" and "crosses" at each intersection of cable trays. Provide "blind ends" at the end of each cable tray "run".
- G. Provide removable fire blocking "bag style" at cable tray penetrations of fire barriers.

END OF SECTION 27 05 36

SECTION 27 08 00
COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Requirements of this Section apply to all Sections of Division 27.
- B. This Project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 81 00 Commissioning. The Commissioning process, which the Contractor is responsible to execute, is defined in Section 01 81 00 Commissioning. A Commissioning Agent (CxA) appointed by the VA will manage the Commissioning process.

1.02 RELATED WORK

- A. Section 01 81 00 Commissioning

1.03 SUMMARY

- A. This Section includes Requirements for Commissioning the Facility Communications Systems, related subsystems and related equipment. This Section supplements the General Requirements specified in General Commissioning Requirements.
- B. Refer to General Commissioning Requirements for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.04 DEFINITIONS

Refer to General Commissioning Requirements for definitions.

1.05 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 27 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance Personnel in accordance with the Requirements of Division 27, is required in cooperation with the VA and the Commissioning Agent.

1.06 SUBMITTALS

- A. The Commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of Submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Shop Drawings, Product Data, and Samples for further details.
- B. The Commissioning Process Requires Submittal Review simultaneously with engineering review. Specific Submittal Requirements related to the Commissioning process.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONSTRUCTION INSPECTIONS

Commissioning of Communications systems will require inspection of individual elements of the communications system construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with the Commissioning Plan to schedule communications systems inspections as required to support the Commissioning Process.

3.02 PRE-FUNCTIONAL CHECKLISTS

The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Submittal Requirements for Pre-Functional Checklists, Equipment Startup Reports, and other Commissioning Documents.

3.03 CONTRACTORS TESTS

Contractor tests as required by other Sections of Division 27 shall be scheduled and documented in accordance with General Requirements. All testing shall be incorporated into the Project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.04 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady State conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare Detailed Systems Functional Performance Test Procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed.

3.05 TRAINING OF VA PERSONNEL

Training of the VA Operation and Maintenance Personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, Factory Authorized Personnel to provide instruction to Operation and Maintenance Personnel concerning the location,

operation, and troubleshooting of the installed systems. Contractor shall submit Training Agendas and Trainer resumes in accordance with the Requirements. The Instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of Formal Training Plans. Refer to Division 27 Sections for additional Contractor Training Requirements.

END OF SECTION 27 08 00
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SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.01 GENERAL

- A. Build-out (installation of racks, cabinets, cable runway, cable management, etc.) of Instructional Building #2, Building-Entry, BDF and IDF shall be provided by the Cabling Contractor.
- B. Backboards, conduits, sleeves, power and grounding in the Instructional Building #1, Building-Entry, BDF and IDF shall be provided by the General and Electrical Contractor.

1.02 SECTION INCLUDES

- A. Installation of Freestanding and Wall-Mount Equipment Racks
- B. Installation of Cable Management — Vertical and Horizontal
- C. Installation of wall-mounted 110 Termination Blocks
- D. Installation of Backbone UTP Protection Panels and Units
- E. Installation of Category 6 UTP Patch Panels
- F. Installation of Category 6 UTP Patch Cables
- G. Installation of Fiber Optic Patch Panels
- H. Installation of Fiber Optic Patch Cables
- I. Installation of Grounding
- J. Installation of Overhead Cable Runway
- K. Installation of Voice Cross-connects

1.03 SYSTEM REQUIREMENTS

- A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.
- B. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in backbone cables, and provide spare positions in cross-connects and terminal strips to accommodate 20% future increase in active services.

1.04 MOUNTING ELEMENTS

- A. Backboards: 0.75-inch, ACX interior-grade, fire-retardant-treated plywood painted with two coats of fire-retardant white paint.
- B. All free standing racks and cabinets shall be seismically securely to Requirements to the concrete floor using minimum .25-inch hardware or as required by Local Codes.
- C. Racks shall be placed with a minimum of 36 inches clearance from the walls on three sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at one end of the row.
- D. All racks and cable runways shall be grounded to the telecommunications grounding bus bar in accordance with Grounding System Requirements.

- E. Rack-mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- F. Wall-mounted termination block fields shall be mounted on 4 feet by 8 feet by 0.75-inch ACX void free plywood. The plywood shall be mounted vertically 12 inches above the finished floor. The plywood shall be painted with two coats of white fire retardant paint. Wall-mount termination block fields shall be installed with the lowest edge of the mounting frame 18 inches from the finished floor.

PART 2 - PRODUCTS

2.01 TWO-POST RACKS

- A. Two-post racks shall have power distribution and cable management for server and net-working applications in IT environments.
- B. ICT Contractor shall provide, install, ground and seismic brace 2-post racks in the BDF and IDF's.
- C. The unit shall conform to TIA-610 Standard for, Racks, Panels and Associated Equipment and accommodate industry standard 19-inch rack mount equipment.
- D. The unit shall be designed with four vertical posts to allow rack mount equipment installation utilizing four vertical mounting rails.
- E. The unit shall provide 45U of equipment vertical mounting space (1U—1.75-inch or 44.45mm).
- F. The vertical mounting rails shall be adjustable to allow different mounting depths.
- G. The unit shall include at least 50 sets of mounting screws, caged nuts, bolts and cup washers, and caged nut installation tool for the mounting of equipment inside the unit.
- H. All weight bearing components shall be constructed from steel no less than 0.9mm (20 gauge).
- I. All metal parts shall be painted using a powder coat paint process.
 - 1. Racks shall be black over a brushed aluminum finish.
- J. Plastic materials shall comply with Underwriters Laboratory Specification 94 with V-1 rating (UL94 V-1) or better.
- K. Provisions shall be provided for all rack-mounted equipment to be earthed or grounded directly to the frame.
- L. Unit shall include a grounding kit containing terminated green/yellow jumper wires and associated hardware.
- M. Units shall be equipped with vertical and horizontal wire management.
- N. Racks will require two PDU brackets per cabinet.
- O. Freestanding modular aluminum units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
- P. Material:
 - 1. Approximate Module Dimensions: 84 inches high by 19 inches wide by 3 inches channel depth.
 - 2. Racks shall be all high strength, lightweight 6061-T6 aluminum extrusion construction.

3. Racks shall be equipped with two top angles or top bars and heavy-duty assembly hardware.
4. Racks shall have EIA hole pattern on front and rear.
5. Racks shall assemble as 19 inches with no additional hardware.
6. Racks shall have EIA Channel: 3 inches x 1.265 inch x 0.25 inch thick flange.
7. Racks shall have Base Angles: 3.5 inches by 6 inches by 0.125 inch thick (pair).
8. Racks shall have Top Angles: 1.5 inch by 1.5 inch by 0.25 inch (pair).
9. Racks shall have Top Bars: 1.5 inch by 0.25 inch (pair).
10. Racks shall have a weight capacity of 1000 lbs. Weight must be evenly distributed.
11. Racks shall be black over a brushed aluminum finish.
12. Racks shall provide floor and ceiling access for cable management and distribution.
13. Racks shall provide pre-drilled base for floor attachment of rack.
14. Racks shall be seismic/earthquake braced.
15. Racks shall be black in color.
16. Contractor shall provide cable runway elevation kit,

Q. Manufacturer:

1. Chatsworth Products, Inc. p/n# 55053-703
2. Or Equal

2.02 HEAVY DUTY EQUIPMENT SHELF FOR 3-INCHES CHANNEL

- A. Shelves, black in color, shall be installed at the bottom of freestanding racks. These 20-inches deep, 200 lb. rated shelves are needed to support UPS units.
- B. Manufacturer:
 1. Chatsworth Products, Inc.
 2. Or Equal

2.03 CABLE RUNWAY (LADDER RACKING)

- A. Cable Runway Support shall be installed in Telecommunications Rooms as shown on the Drawings. Size: 18 inches wide.
- B. Classified by Underwriters Laboratories (UL) as suitable for equipment grounding.
- C. Cable Runway shall be used for voice and, or data and video communications cabling only. No electrical wiring shall be placed on runway with voice and data cabling.
- D. Wall angle supports shall be steel angles. Ends to be smooth without hooks or projections. Brackets shall be able to support an end load of 600 lb. with a safety factor of 1.65.
- E. Elbows, Tee's, 90degree bends and crosses: All horizontal and vertical 90 degree elbows, tees, 90 degree bends and crosses shall be made with right angle couplings which clamp to the runway without the need for drilling or cutting.
- F. At all horizontal 90-degree bends, tees, and crosses, provide adjustable junction splice kits for large radius cable bends.

- G. Where cables transition from runway to termination equipment or racks, provide cable radius managing waterfall attachments.
- H. Seismically supported by end wall supports, angular wall support and communications equipment racks.
- I. Protective End Caps on all exposed cable runway ends.
- J. Black baked enamel finish.
- K. Manufacturer:
 1. Chatsworth Products, Inc.
 2. Or Equal

2.04 WIRE MANAGEMENT

- A. Materials
- B. All equipment racks shall be equipped with vertical and horizontal wire management organizers. All horizontal wire managers shall be heavy duty painted black metal units designed specifically to connect to equipment frames. All vertical wire managers shall be aluminum with a black finish. All wire managers shall be secured to the frames and shall provide a clear and unobstructed pathway in which to route the cables.
 1. The Vertical cable manager shall be constructed of metal backbone with pass through holes and plastic cable management fingers.
 2. The cable management fingers shall be molded out of plastic and incorporate bend radius control throughout the entire length.
 3. The panel shall have a metal door that will be capable of opening to the left or right when mounted.
 4. The panel shall be capable of mounting to EIA standard channel, deep channel and telco style racks.
 5. Vertical wire managers shall be double-sided 4.4 inches wide by 7 feet tall. Vertical wire managers shall have evenly 1 RMU spaced wire rings designed to maintain jumper, patch, or cross-connect wire in place.
 6. Vertical wire managers shall be designed to extend past the frame to allow placement of equipment in any position within the rack. When mounted between equipment frames, they shall be designed to direct cables into either frame and shall be securely mounted to both units.
 7. Vertical wire managers shall be equipped with rigid aluminum Switch Gate Door/Cover with reversible access that conceals cable.
 8. Vertical wire managers shall be provided black in color.
- C. Horizontal Wire Managers (Equipment Racks)
 1. The in-frame horizontal managers shall be 2 RMU in height and shall extend from side rail to side rail.
 2. Double-sided design and pass-through slots for easy organization of front and rear cables.
 3. Include cable guide fingers at 1.75-inch intervals for proper cable bend radius and organization of patch cords.

4. Flanged pass-through slots to route cables to the back.
 5. Include Snap-on, hinged door/cover.
 6. Black in color.
- D. Horizontal Wire Managers (Wall-Mount Brackets)
1. Shall be 2 RMU in height and shall extend from side rail to side rail.
 2. Single-sided design.
 3. Include cable guide fingers at 1.75-inch intervals for proper cable bend radius and organization of patch cords.
 4. Include Snap-on, hinged door/cover.
 5. Black in color.
- E. Cable Management for Wall Racks
1. Cable management rings shall be installed on wall-mount racks.
 2. Black polymer-blend material that is UL Rated for use in plenum spaces.
 3. Flexible material holds bundles secure while also allowing easy entrance of additional cables.
 4. Internal diameter 3-inches.
 5. Kit includes six rings and mounting hardware
- F. Manufacturer:
1. Chatsworth Products, Inc.
 2. Or Equal

2.05 PLYWOOD BACKBOARD

- A. The General Contractor shall provide and install all MPOE and Telecommunications Room backboards.
- B. Provide 0.75-inch (19.05 mm) ACX void-free, fire rated plywood as noted on Construction Documents.
- C. All walls noted on construction documents must be covered with 0.75 inch (19.05 mm) thick by 8-feet 0-inches (2438.4 mm) high ACX plywood, painted with two coats of insulating fire-retardant white paint.
- D. Backboards shall be mounted vertically, starting 6 inches (152.4 mm) above the finished floor, and secured to the walls.
- E. All backboards are to be constructed of 4 feet (1219.2 mm) by 8 feet (2438.4 mm) plywood.
- F. All plywood panels must be mounted in contact with one another, leaving no gaps between sheets.
- G. All exposed edges must be chamfered. Screws, bolts, washers and/or nuts are to be counter sunk to be flush with the surface of the plywood,

2.06 WALL-MOUNTED 110 WIRING BLOCKS

- A. Application: Shall be used to terminate voice station and voice backbone cable.

- B. Compliance: Comply with ANSI/TIA-568-B.1 and ANSI/TIA-568-B.2 Category 5 Specifications Requirements and associated addendums, ANSI/TIA-606-B Labeling Standards.
- C. All voice station cable terminations shall be made on wall-mounted 110 wiring blocks with C4 connectors.
- D. Intra-building voice backbone cable terminations shall be made on wall-mounted 110 wiring blocks with C5 connectors.
- E. All blocks shall be UL listed.
- F. Characteristics: The 110 Wiring Blocks shall:
 - 1. Facilitate cross-connection and/or interconnection using either cross-connect wire or patch cords.
 - 2. Be manufactured using fire retardant molded plastic with the base consisting of horizontal index strips for termination up to 25-pairs of conductors.
 - 3. Support termination of 22, 24 and 26 AWG solid conductor.
 - 4. Be available in 50-, 100- and 300-pair sizes. Sizes specified within Drawings contain access opening for rear to front cable routing to the point of termination.
 - 5. Have termination strips on the base to be notched and divided into 4-pair and/or 5- pair increments.
 - 6. Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the basis of circuit size (1-, 3-, 4- or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords.
 - 7. Have bases available in 19-inch (482.6 mm) panels and high-density frame configurations for rack or wall mounting with cable management hardware.
 - 8. Have connecting blocks used for either the termination of cross-connect jumper wire or patch cords. The connecting blocks shall be available in 2-, 3, 4- and 5-pair sizes. All connecting blocks shall have color-coded tip and ring designation markers and be single piece construction.
 - 9. Be capable of accommodating a minimum of 200 repeated insertions without resulting in permanent deformation.
- G. Manufacturer:
 - 1. AMP
 - 2. Panduit
 - 3. Leviton
 - 4. Or Equal

2.07 PROTECTOR PANELS AND UNITS

- A. Application: Inter-building and entrance cable protection will be Vendor's protector panel equipped with protector units. Protector panels shall meet NEC Article 800, Part C Requirements. Protector panels shall provide protection for communications equipment and circuits exposed to voltage surges and sneak currents. The protector panel shall be equipped with 110-style terminations in and out.
- B. Protector Units shall be UL 497 listed for primary circuit protection. Protector units shall provide protection for communications equipment and circuits exposed to voltage surges and

sneak currents. The protector units shall be equipped with solid state surge arrestors for sneak current protection.

- C. Manufacturer:
 - 1. Circa
 - 2. Marconi
 - 3. Or Equal

2.08 UTP CATEGORY 6 PATCH PANELS

- A. Application: Use to terminate all horizontal data station cabling.
- B. Compliance: Listed as complying with ANSI/TIA-568-B.1 and ANSI/TIA-568-B.2 Category 6 Specifications Requirements and associated addendums, ANSI/TIA- 606-B labeling standards.
- C. Characteristics: Patch panels shall:
 - 1. Be available in 48-port high-density configurations.
 - 2. Modular Patch Panels shall be of a metal design with snap in four position and six position molded faceplate frames.
 - 3. Patch panels shall be available with labels.
 - 4. Be mountable in freestanding equipment rack.
 - 5. Be labeled above the RJ4S module.
 - 6. Be 2 RMU in height and shall extend from side rail to side rail.
- D. Manufacturer:
 - 1. AMP
 - 2. Panduit
 - 3. Ortronics
 - 4. Or Equal

2.09 UTP CATEGORY 6 PATCH CABLES

- A. UTP Patch Cables. Patch cables for unshielded twisted pair cable shall be Category 6 rated and shall be equipped with factory-attached connectors to interconnect equipment mounted on the racks of the distribution frame and to connect computer stations to outlet locations.
- B. Patch cords may also be used for patching applications; not to exceed 20 feet. Quantity required for 100% port population at both ends with 10% spare.
- C. Contractor shall provide:
 - 1. BDF/IDF Patch Cords — 6-inches in length, Category 6 and colored according to the following:
 - a. Green for instructional network
 - b. Blue for non-instructional network
 - c. White for everything else
 - d. Number of each color to be confirmed with Owner or District Representative.
 - 2. Workstations — 10 feet in length, Category 6, black in color.

- D. Manufacturer:
 - 1. AMP
 - 2. Panduit
 - 3. Ortronics
 - 4. Or Equal

2.10 FIBER PATCH PANELS

- A. Manufacturer: Ortronics or District approved equal.
- B. Provide panel for maintenance and cross connecting of fiber optic cables.
- C. Panel shall be constructed of 0.125-inch minimum aluminum and shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable.
- D. Panels shall be equipped with engraved laminated plastic nameplates above each connector.
- E. Rack-mounted fiber patch panels shall be equipped to terminate or splice the incoming inter-building fiber and any required backbone or interconnect cables.
- F. Each cable must be properly dressed.
- G. These units will terminate the fiber optic cables, provide a place for jumper cables and will provide room to terminate additional optics.
- H. Panel shall provide capacity for minimum of 12 fiber optic strands. Larger capacity patch panels shall be determined at site walk.
- I. Panel shall be 100% populated with type LC couplers and adapter plates.
- J. All connectors and couplers will be type LC.
- K. The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss.

2.11 FIBER OPTIC PATCH CABLES

- A. Manufacturer: Superior Essex, or District approved equal.
- B. Fiber Optic Patch Cables shall be Multimode or Single Mode patch cords pre-made to connect fiber optic equipment with fiber optic cross connects, interconnects and outlets.
- C. The patch cords (jumpers) shall be impact-resistant, duplex fiber cables with LC connectors, of the same performance characteristics as the Single Mode fiber backbone being connected.
- D. These fiber optic patch panel connections shall provide 0.4 dB or less insertion loss and provide connection between the Active LAN devices and the Fiber Optic patch panel. Quantities for 100% fiber strand population at both ends plus 10% Spares.
- E. Contractor shall provide:
 - 1. IDF Patch Cords — 1 Meter in length, LC connectorized, Multimode and Single Mode, duplex, fiber optic patch cord.
 - 2. MDF/BDF Patch Cords — 3 Meter in length, LC connectorized, Multimode and Single Mode duplex, fiber optic patch cord.

2.12 GROUNDING SYSTEM

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks,

cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA- 607 Telecommunications Bonding and Grounding Standard.

- B. The TBB shall adhere to the recommendations of the ANSI/TIA-607 standard, and shall be installed in accordance with industry best practice.
- C. The General Contractor shall be responsible for having a licensed Electrical Contractor provide and install the TBB to the building service entrance ground.
- D. The main entrance facility shall be equipped with a Telecommunications Main Grounding Bus bar (TMGB). The Site MPOE and each Telecommunications Room shall be provided with a Telecommunications Ground Bus Bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached. Installation of building ground systems shall be the responsibility of the Electrical Contractor.
- E. All racks, cable runway, metallic backboards, cable sheaths, etc. entering or residing in the MPOEs and Building Telecommunications Rooms shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors. Bonding of cable sheaths and equipment within these rooms shall be the responsibility of the Cabling Contractor.
- F. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this Specification.
- G. Manufacturer:
 - 1. Chatsworth Products, Inc.
 - 2. Or Equal

PART 3 - EXECUTION

3.01 EQUIPMENT RACKS, SHELVES AND SERVER RACKS

- A. Coordinate all work for final mounting locations of all equipment.
- B. Provide and install all cable runways as defined on Telecommunications Drawings and Specifications.
- C. Provide and install 3/4-inch fire rated plywood backboards within Telecommunications Room as identified within Telecommunications Drawings and Specifications.
- D. Provide and install all equipment racks and cabinets
- E. Provide seismic anchoring of all racks and cabinets to meet compliance.
- F. Provide and install all vertical and horizontal wire managers.
- G. Provide and install required rack-mounted patch panels and wall-mounted 110 termination hardware.

3.02 CABLE MANAGEMENT

- A. Provide and install two vertical wire management panels to each 19-inch x 7-foot equipment rack installed.
- B. Provide and install one 2U horizontal wire management panel for each UTP patch panel and fiber optic enclosure installed.

3.03 UTP PATCH PANELS

- A. Provide and install 48-port, Category 6 patch panels within Telecommunications Rooms.
- B. Contractor shall verify and provide exact quantities required.

3.04 FIBER OPTIC PATCH PANELS

- A. Provide and install fiber optic patch panels within the building MPOE and Building Telecommunications Rooms.
- B. Provide and install necessary adapter and blank panels.

3.05 VOICE TERMINATION BLOCKS

- A. Provide and install 110 type termination blocks with wiring troughs within Telecommunications Rooms.
- B. Provide lightning protection termination terminals for all outside plant/underground cable installed.
- C. Contractor shall verify and provide quantities required.

3.06 CROSS CONNECTS

- A. Provide all cross-connect (1 pr. hook-up) wire required in the Instructional Building #1 MPOE and TRs.
- B. Backbone cable to backbone cable, cross-connect all pairs.
- C. Backbone to voice station cable and emergency telephone cable, cross-connect one pair per station.

3.07 CABLE RUNWAY (LADDER RACKING)

- A. Provide and install all ladder rack as defined within the Telecommunications Drawings.
- B. Provide and install all required mounting/supporting hardware required.

3.08 TIE WRAPS

Provide and install Velcro cable ties to manage and secure all installed cables within MPOEs and Telecommunications Rooms.

3.09 GROUNDING

- A. The Electrical Contractor shall provide and install the Telecommunications grounding system to each MPOEs and Telecommunications Rooms.
- B. Provide and install grounding bus bars within MPOEs and Telecommunications Rooms as identified on the Telecommunications Drawings.

- C. The Cabling Contractor shall provide and install grounding within BDF and IDF Rooms as follows.
1. Inter-building cable sheaths shall individually bonded to the TGB.
 2. Each rack shall be individually bonded to the TGB.
 3. Each cable runway section shall be bonded together with ground straps.
 4. Cable runway strapped system shall be bonded to the TGB.
 5. Ground all equipment within Telecommunications Room with a minimum #6 AWG conductor.

END OF SECTION 27 11 00
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SECTION 27 20 00
ELECTRONIC NETWORK SYSTEMS INFRASTRUCTURE

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26.
 - 2. General Provisions and Requirements for electrical work.
- B. Provide Electronic Network Systems Infrastructure for the following systems:
 - 1. Computer Data Networks
 - 2. Telephone and Intercom Voice Communications
 - 3. Other special systems described in the Contract documents.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Drawings Submittals
 - 1. Drawings shall be submitted on reproducible sepias and AutoCAD[®] Version 2.2 (or later revision) data files on CD/DVD-ROM disk, WINDOWS[®]-XP or Version-7 or Version-8 format.
 - 2. Submit redrawn Building Floor Plan for each building area, same scale as the Contract Drawing.
 - 3. Plans shall show walls, doors, windows, furniture, infrastructure, outlets and network systems equipment locations. Show point-to-point interconnecting cables, pathways, conduit, conduit sizes, circuit types, along with circuit identification names, numbers and quantities between all components.
 - 4. Provide scaled Elevation Drawings of each equipment rack, terminal blocks, terminal backboard and terminal room/closet showing location and arrangement of each equipment component, outlet and cable training provisions, with estimated weight of each complete assembly.
 - 5. Submit block wiring diagrams showing major system components, outlets, equipment racks, terminal blocks, signal loss with interconnecting circuit conductors, splices, portable patch cords and connectors. Riser type diagram shall be provided if the building has more than one floor level, with information shown on riser diagram corresponding for each respective floor.
- B. Submit Manufacturer's standard catalog data for each component. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The Manufacturer's data sheets shall be marked to indicate the specific item being proposed in

cases where the sheet covers several types or sizes of items. The data sheet shall completely describe the proposed item. Where modification to the equipment is necessary to meet the operational Requirements of the Contract Documents, the brochure shall include complete Mechanical and Electrical Shop Drawings, detailing the modification. The brochure shall include a listing of the Outlet Rough-In Requirements for every device and equipment item. The applicable symbol which illustrates that rough-in item on the Job Plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel. Submit elevation and dimensional information.

C. Performance Calculation:

1. Provide engineered calculations showing the Passive Cable System Signal Attenuation losses of the proposed installed system. The intent is not to require calculations for every system segment, port and outlet. The intent is to require engineered calculations for proposed typical worst case port to port; head end to farthest distance outlet and patch port to outlet signal attenuations.
2. Provide calculations for a minimum of 50 complete channel/circuit paths. The calculations shall include attenuation insertion losses for each system component including individually itemized cable-fiber/wire; outlet, termination, connector, electronic component (if any), coupler and patch cord along the entire path from the head end equipment to the end use outlet.
3. The calculations shall serve as the basis for verifying the system performance with the system testing specified in the Contract Documents.

D. Provide proposed nameplate and outlet identification/color coding system. Indicate proposed identification naming sequence and methods, itemized for review.

E. Submit Manufacturer Certified Test Reports showing test documentation for the proposed material that the material meets or exceeds the performance standards defined in the Contract Documents. The testing and results shall reflect worst case performance based on a minimum of ten samples. Tests shall be certified by a Nationally Recognized Independent Test Lab (i.e., ETL, UL, etc.). The Manufacturer shall certify in writing the material has been manufactured and tested to comply with the Requirements defined in the Contract Documents.

F. Submit three samples of each of the following, fully assembled with 24-inches of cable type connected:

1. Copper wire outlet and connector, with each type of specified inserts.
2. Copper cables and patch cords, each type.
3. Fiber optic cables and patch cord each type.
4. Mechanical splice - fiber optic.
5. Fusion splice - fiber optic.
6. Fiber optic outlet and connector each type.
7. Fiber optic cable connector each type of termination, with interconnection coupler.
8. Patch panel each type.
9. Coverplate each type.

1.03 APPLICABLE STANDARDS

- A. Individual component Production/Manufacturer Testing and Labeling.
 - 1. The equipment shall be UL listed, labeled, and approved for the application shown in the Contract Documents.
 - 2. ETL (USA) each network systems infrastructure component. Third party testing, documentation and certification for performance compliance of each component with the UL, ANSI, TIA and EIA Applicable Standards specified in the Contract Documents.
- B. The complete system material, equipment, testing, installation, workmanship and installed performance shall comply with the Mandatory Requirements and the Guideline/ Recommendation Requirements of the following latest Published Version, Supplements, latest revision including Addendums and TSB. Both the mandatory and advisory criteria shall be included as Requirements of the Contract Documents:
 - 1. TIA-526 Optical Power and loss measurements – multimode and single mode fiber.
 - 2. ANSI/TIA/EIA-568C Commercial Building Telecommunications Standards.
 - 3. ANSI/TIA/EIA-569B – Commercial Building Standards for Telecommunications Pathways.
 - 4. ANSI/TIA/EIA-570A Residential Telecommunications Standard.
 - 5. ANSI/TIA/EIA-598B Optical Fiber Cabling Color-Coding.
 - 6. ANSI/TIA/EIA-606A Administrative Standard for Commercial Telecommunications Infrastructure.
 - 7. ANSI/TIA/EIA-607 Commercial Buildings Grounding and Bonding Requirements for Telecommunications.
 - 8. FCC – FYU/FT6.
 - 9. ISO/IEC 11801
 - 10. National Electrical Code (NEC) and California Electrical Code (CEC) including Articles 770 and 800 with ETL verified Testing and Local Code jurisdictions.
 - 11. NECA/NEIS, National Electrical Contractors Association, National Electrical Installation Standards:
 - a. 301 – Standard for Installation and Testing for Fiber Optic.
 - b. 568 - Standard for Installing Building Telecommunications Bonding and Grounding.
 - c. 607 - Telecommunications
 - 12. Manufacturer's recommendations for the respective equipment.
- C. Network Performance
 - 1. The entire completed Electronic Network Systems Infrastructure shall be tested and provide electronic data/network and telephone/voice multi-channel communications latest Revisions, Standards and Addendums for the following protocols:
 - a. IEEE 802.3/ETHERNET latest revisions.
 - 2. Twisted pairs copper wire (100 meter path length unless indicated otherwise)
 - a. 10Mbps 10Base-T, 100Mbps 100Base-Tx;
 - b. 1000Mbps (1Gbps) 1000 Base-Tx;
 - c. 10,000 Mbps (10Gbps) 10Gb Base-Tx.

- d. IEEE-802.3 for Power Over Ethernet (POE) and Power Over Ethernet-Plus (POE Plus).
- 3. Fiber optic, 550 meter communications pathway distance, OM4 standard multimode and OS2 single-mode.
 - a. 10Mbps 10Base-F1, 100Mbps 100Base-FX,
 - b. 1000Mbps 1000Base-Lx-Sx
 - c. 10,000 Mbps (10Gbps) for fiber optics
 - d. Single Mode path length performance increase Requirement to 3000 meters.
- 4. IEEE 802.5/TOKEN RING.
- 5. APPLETALK (Phone-net).
- 6. FDDI - Distributed data interface on fiber or copper wire, 100Mbps.
- 7. 100VG – Any LAN
- 8. TIA/EIA serial and Bi-directional RS-232 and RS-485, including Star-Hub repeaters.
- 9. ANSI - TPPMD 55Mbps, 155Mbps and 622Mbps Asynchronous Transfer Mode - ATM.
- D. The Complete Telephone/Voice Infrastructure System shall be suitable for the telephone/voice analog and digital communications and VoIP protocols. The system shall be compatible with the telephone/voice equipment installed as part of the Contract.
- F. Installation of All Infrastructure Equipment, Devices, Splices, Terminations, Cables, Outlets, etc. shall comply with Manufacturer's recommendations.

1.04 EQUIPMENT QUALIFICATIONS

- A. Equipment
 - 1. The Supplier of the equipment shall be the Factory Authorized Distributor and service facility for the brands of equipment and material provided.
 - 2. Network systems infrastructure equipment and materials shall all be the product of one of the individual same Manufacturers as follows. Typical unless specifically described otherwise:
 Belden – 10GX Series; or CommScope-Systimax X10D Series;
 or AMP/Tyco – NetConnect Series;
 or Ortronics/Legrand – NetClear Series;
 or Siemon – ConvergeIT Series.
- B. Installation Certification
 - 1. Work and material for cables, cable terminations, outlets and related components for infrastructure systems shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.
 - 2. The Manufacturers of the indicated work and material shall provide an Installer education/training and certification program for the supplied products.
 - 3. The Installers performing the Contract Work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.

4. Submit six copies of the Manufacturer's Certifications for each installer performing the work. The submittal shall be approved by the Owner's Representative prior to initiating any related Contract Work.
 5. Contract material installed and work performed by Installers not complying with these Requirements shall be removed. Removal of work and material not in compliance with these Requirements shall be done at the Contractor's expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-complying removed work and material shall be provided at the Contractor's expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.
- C. Extended Material and Performance Warranties
1. In addition to the warranty Requirements described elsewhere in the Contract Documents, provide the following extended material and performance warranties. The warranty period shall be for not less than 15-years from the Contract Notice of Completion.
 2. Warranty scope includes materials and performance for network cables and terminations, network workstation plug-in outlets, and patch panel plug-in outlets, cable splices and connectors.
 3. Repair or replace the defective material with new material at the Project premise, to comply with the performance standards outlined in the Contract Documents during the warranty period.
 4. Submit seven copies of proposed warranty statements, with Shop Drawing submittals.

1.05 ABBREVIATIONS

<u>Abbreviation</u>	<u>Terminology</u>
ACR.....	Attenuation to Cross Talk.
AHJ	Authority Having Jurisdiction.
Backbone.....	Circuit interconnections between MDF and IDF patch panel locations.
dB	Decibel.
dBm	Decibel referenced to a milliwatt.
Demarc.....	Demarcation location where operational control change occurs or ownership change occurs.
ft.....	Feet.
GHz	Gigahertz.
Gbps	Gigabits per second.
Horizontal Connection, and/or Horizontal wiring	Circuit interconnections between individual workstation outlet location to respective IDF or MDF equipment rack patch panel.
IDF	Intermediate Distribution Frame (horizontal or vertical cross connect) for an individual building area/floor.
km	Kilometer-1km.
kPSI.....	1000 pounds per square inch.
m	Meter = 39.37 inches.
Mbps	Megabits per second.

MDF.....	Main Distribution Frame (central/main cross connect) for multi-building site or for a single individual building.
MHz.....	Megahertz.
MIC.....	Micrometer
mm.....	Millimeter = 10 ⁻³ meter.
NEXT.....	Near end cross talk.
nm.....	Nanometer = 10 ⁻⁹ meter.
pF.....	Picofarad = 10 ⁻¹² farad.
Provide.....	Furnish, install and connect.
RTDE.....	Equipment rack mount fiber optic termination distribution enclosure, with fiber optic patch panel.
RMSE.....	Equipment rack mount fiber optic enclosure, splice only (without patch panel).
STP.....	Shielded individual twisted pairs copper wire.
ScTP.....	Shield Screened Twisted Pairs copper wire.
Trunking-Cable.....	Individually insulated twisted pair copper wire cable, consisting of 24-pair or more of conductors inside a common cable jacket. Terminate and connect to common terminal-block location at each end of the trunking-cable.
um.....	Micrometer = 10 ⁻⁶ meter.
USE.....	Universal Splice Enclosure.
UTP.....	Unshielded twisted pairs copper wire.
VoIP.....	Voice communications Over Internet Protocol.
WGNA.....	Wide Band Gigabit Networking Alliance.
Workstation or.....	Spaces remote from the MDF/IDF terminal room/closet, where user equipment interacts and connects with the electronic systems infrastructure equipment connection outlet device.
Workstation location	
WMIC.....	Wall Mount fiber optic cable Interface Cabinet.

1.06 MATERIALS AND METHODS

- A. Material and Labor not complying with the Contract Documents shall be removed by the Contractor from the Project Site. Material and labor complying the Contract Documents shall be provided.
- B. All the cost to remove deficient work and material, provide work and material complying with the Contract Documents and the direct, indirect, incidental damages and Contract delays resulting from complying with these Requirements shall be the sole responsibility of the Contractor and shall be included in the bid price.

C. System Performance Requirements

1. The work, performance and type of materials provided as part of the Contract shall comply with the following ANSI/TIA/EIA-568C and related standards for all Electronics Network Systems Infrastructure work and materials described in the specifications and shown the Drawings:
 - a. Computer/data network systems: Category-6A
 - b. Telephone/intercom voice systems: Category-6A
 - c. Broadband transmission radio frequency for television, digital or analog cable television, digital satellite system, broadcast quality Coaxial-RG6 (QUAD SHIELDING).
 - d. Trunking-cable, analog circuits copper wire twisted pairs: Category-5E.
2. The Electronic Network Systems Infrastructure system shall be based on “Star-Topology”; for MDF to IDF backbone connections and workstation outlet to MDF/IDF horizontal connections.

PART 2 - PRODUCTS

2.01 FIBER OPTICS CABLES

A. General

1. Operating temperature range - 20 degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
2. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “Limited Combustible Cable” (LC or LCC) and shall comply with the latest published revision of all of the following Additional Requirements.
 - a. Limited combustible “FHC-25/50” per UL-2424.
 - b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, fiber optic “FHC-25/50-CMP and/or OFNP/OFCP”.
 - c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.
 - d. NFPA-5000; defines combustible material including wire and cable.
 - e. NFPA-75 computer rooms and electronic equipment room.
 - f. NFPA-13; spaces containing “limited combustible loading”.
3. Cables shall qualify as 100% recyclable materials disposal, RoHS regulation complaint.
4. All fibers in a multi-fiber cable shall be fully operational within the performance characteristics specified prior to and after the cable is installed. The use of spare fibers in the cable to compensate for defective fibers is not permitted. Defective cables shall be removed and replaced with fully functional cables at no additional cost to the Contract.
5. Cables shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with Specified Requirements. ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

6. Each fiber shall be individually identified with factory color-coding or factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with Agency listing identification.
7. Fiber optic cable shall be a product of the same Manufacturer, including portable patch cables.
8. Cables installed in raceways or conduits below grade, through in-grade manholes or pull-boxes shall be rated for installation in water/wet locations.
9. Provide overall outer jacket enclosing all fibers inside jacket. Cables containing less than seven fiber strands shall be provided with a color coded outer jacket (red or orange).
10. Multimode (62.5/125)
 - a. Fiber optic cables optical fibers, (62.5/125) graded index multimode optical glass fibers, 62.5 micron fiber core and 125 micron fiber cladding, 0.275 numerical aperture. Optical fibers shall be 100 kpsi proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.
 - b. Minimum bandwidth:

@ 850nm - wave length	160MHz per km length
@ 1300nm - wave length	500MHz per km length
 - c. Maximum attenuation:

@ 850nm-wave length	3.4 dB @ 1km length
@ 1300nm-wave length	1.0 dB @ 1km length
 - d. Laser-optimized "OM2" optical multi-mode standards.
11. Multimode (50/125)
 - a. 50/125 fiber optic cables optical fibers, graded index multimode optical glass fibers, 50.0-micron fiber core and 125-micron fiber cladding, 0.2 numerical apertures. Optical fibers shall be 100 kPSI proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.
 - b. Minimum bandwidth:

@ 850nm-wave length	3500Mhz per km length
@ 1300nm-wave length	500Mhz per km length
 - c. Maximum attenuation:

@ 850nm-wave length	3.0db @ 1km length
@ 1300nm-wave length	1.0db @ 1km length
 - d. Laser-optimized "OM4" optical multi-mode standards.
12. Single mode:
 - a. Fiber optic cables optical fibers, (8.3/125) single mode optical glass fibers, 8.3-micron core fiber and 125-micron fiber cladding, 0.11 numerical apertures. Optical fibers shall be 100-kPSI proof tested, with maximum 0.7-micron flaw size for operation at 1310nm and 1550nm wave lengths.
 - b. Maximum attenuation:

@ 1310nm- wave length	0.5 dB @ 1km length
@ 1550nm- wave length	0.4 dB @ 1km length

- c. Maximum dispersion
 - @ 1310nm- wave length 2.8 ps/nm km length
 - @ 1550nm- wave length 8.0 ps/nm km length
- d. Laser-optimized "OS1"/"OS2" optical single mode standards.

B. Loose Tube Gel-filled Cables

1. Multiple, loose tube buffer tubes, gel-filled. Each buffer tube shall contain the same quantity of optical fibers, but not more than twelve optical fibers in each buffer tube.
2. Buffer tubes shall be cabled around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
3. Aramid yarn, non-optical, strength fibers shall extend continuously along the length of the cable.
4. The cable interstitial spaces shall be flooded to inhibit water migration, with non-flammable water blocking gel.
5. Each optical fiber shall be individually UV cured acrylate coated, 250-micron diameter coating over fiber cladding.
6. A seamless black polyethylene outer layer jacket shall envelope the entire cable.
7. The cable shall be fungus resistant, UV resistant, and moisture resistant for installation indoors with or without an enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/ pullboxes continuously flooded with water.

C. Indoor/Outdoor Cables

1. The cable shall be fungus resistant, UV resistant, moisture resistant for installation indoors with or without an enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/ pullboxes continuously flooded with water, and in conduits exposed to the sun.
2. Each optical fiber shall be primary coated with 500 micron uniform acrylate tight buffered and with elastomeric uniform 900-micron diameter tight buffered, secondary coating. Aramid yarn strength member elements shall be tensioned and symmetrically and uniformly distributed around the fibers, along the length of the cable.
3. An overall cable jacket uniformly extruded directly around and mechanically interlocked with the optical fibers/strength members. The extruded jacket shall form internal helical cusped ridges that interlock with the optical fibers and strength members. The interlocking jacket shall not allow cable fibers to move axially within the cable jacket.
4. Cables containing more than twenty-four optical fibers shall be constructed with sub-cable fiber bundles. Each sub-cable bundle shall contain equal quantities of optical fibers, with a separate PVC jacket around each sub-cable. Sub-cable and sub-cable jacket construction shall match the overall Cable Requirements and Jacket Requirements.
5. The cable shall be UL listed and comply with NEC and NFPA Requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed Specified Requirements.
 - a. NEC – OFNR (Vertical Riser Type Locations) OFNP (UL FHC-25/50 LC Plenum Type Locations and locations where not continuously enclosed inside conduits for entire cable length).

- b. NEC – OFNG (Where continuously enclosed inside conduits for entire cable length).

D. Tight Buffered Cables

1. Each optical fiber shall be coated, 900-micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
2. Individual multiple optical fiber assemblies shall be symmetrically arranged around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
3. A dielectric strength member shall surround the fiber assemblies.
4. An outer dielectric jacket shall envelope the entire cable.
5. The cable shall be UL listed and comply with NEC and NFPA Requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed Specified Requirements.
 - a. NEC – OFNP (UL FHC-25/50 LC Plenum type locations and locations where not continuously enclosed inside conduits for entire cable length).

2.02 COPPER WIRE CABLES (TWISTED PAIRS)

A. General

1. Conductors shall be copper wire, individually insulated and color coded, with multiple conductors arranged in twisted pairs.
2. An overall non-conductive jacket shall encase the copper wires and any shielding (where shielding is specified) shall also be encased by the jacket.
3. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA Requirements for each installation location shown. ETL tested and certified to comply with or exceed Specified Requirements.
 - a. NEC – MPP/CMP, FHC-25/50 (Plenum type locations and locations where not continuously enclosed inside conduit).
 - b. NEC – MPR/CMR (Vertical riser type locations).
 - c. ANSI/TIA/EIA-568C; including related Standards, Amendments and TSB.
4. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “Limited Combustible Cable” (LC or LCC) and shall comply with the latest published revision of all of the following Additional Requirements.
 - a. Limited combustible “FHC-25/50” per UL-2424.
 - b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, copper wire “FHC-25/50-CMP”.
 - c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.
 - d. NFPA-5000; defines combustible material including wire and cable.
 - e. NFPA-75 computer rooms and electronic equipment room.
 - f. NFPA-13; spaces containing “limited combustible loading”.

5. Cables shall qualify as 100% recyclable materials disposal, RoHS regulations complaint.
 6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall also be UL listed and labeled for installation in air plenums.
 7. Cables installed in raceways or in conduits below grade, or through in-grade manholes and pullboxes, shall be rated for installation in water/wet locations.
 8. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number and Agency (AHJ) listing identification.
 9. Copper wire Electronic Network Systems Infrastructure cable shall be a product of the same Manufacturer, including portable patch cables.
 10. The outer jacket of cables with less than nine pair of conductors shall be color-coded. The jacket color shall be different for each system type; multimedia; telephone/voice; computer/data network; and fiber cable jackets.
 11. 300-volt RMS insulation material for each data conductor shall be the same material; shall be the same electrical characteristics and shall be the same dielectric constant, for all data conductors contained within the respective common cable jacket, along the entire installed length of the cable. Data cables employing differing insulation materials for individual data conductors contained within a common cable jacket are not acceptable and shall not be provided.
 12. Propagation and "Skew" Rate
 - a. Skew rate (nominal velocity of propagation delay) between any twisted pair in a combination of 4-twisted pair conductors grouped in the same cable, shall not exceed 35-nano seconds between any wire pair contained in the conductor group, and as required by the cable Category rating, over a cable length of 328-feet (100 meters), for all frequencies up to the cable maximum frequency rating.
 - b. Nominal velocity of propagation, exceeding 70% of the speed of light.
 13. Large capacity feeder cables and trunking-cables
 - a. Copper wire cables with more than 24-twisted pairs of conductors shall be constructed with 25-pair binder groups of conductors. The cable binder groups shall be enclosed in colored binders and assembled to form a single cable. The twisted pair/binder groups shall be enclosed with multi-layer dielectric protective sheaths underneath a cable jacket enclosing the entire cable assembly. A corrugated metal 100% shield shall be provided under the cable jacket enclosing all conductors.
 - b. Cables shall be wet location rated and listed for installation in conduit, where the conduit is in a wet environment and/or high-temperature environment, including:
 - Underground conduit.
 - Inside manholes and pull boxes.
 - Outdoor conduit exposed to weather and/or sunlight.
 - c. ANSI/TIA/EIA Category rating of cable assembly shall be Category-5E, trunking-cable.
- B. Category-5E Computer/Data Enhanced Cables – UTP (trunking-cable)
1. Category-5E cables shall be tested and shall pass ANSI/TIA/EIA test recommendations for Category-5E.

2. Operational characteristics:
 - a. Wire size 24AWG solid copper (24AWG stranded copper for portable patch cables)
 - b. Quantity of twisted pairs As indicated but in no case less than 4-twisted pairs
 - c. Impedance 100 OHM \pm 15%, 3-100MHz
 - d. Maximum Signal Attenuation Per 300 feet (100 meters)

6.3dB @ 1MHz
13dB @ 4MHz
18dB @ 8MHz
20dB @ 10MHz
25dB @ 16MHz
28dB @ 20MHz
32dB @ 25MHz
36dB @ 31.25MHz
52dB @ 62.5MHz
67dB @ 100MHz
 - e. Mutual Maximum Capacitance of Any Pair 14pf/feet
 - f. Worst Pair "NEXT" Loss Per/328-feet (100 meters)

62dB @ 1Mhz
53dB @ 4Mhz
48dB @ 8Mhz
47dB @ 10Mhz
44dB @ 16Mhz
42dB @ 20Mhz
41dB @ 25Mhz
40dB @ 31.25Mhz
35dB @ 62.5Mhz
32dB @ 100Mhz

3. ScTP, all the wires in the cable shall be enclosed in a common, 100% metallic foil shield with copper "drain" wire, shield and drain wire located under the cable jacket.

C. Category-6 Computer/Data Enhanced Cables – [ScTP] [UTP]

1. Category-6 cables shall be tested and shall pass the ANSI/TIA/EIA test recommendations for Category-6.
2. Operation Characteristics:
 - a. Wire size 23AWG solid copper (23AWG stranded copper for portable patch cables)
 - b. Quantity of twisted pairs As indicated but in no case less than 4-twisted pairs
 - c. Impedance 100 OHM \pm 15%, 1-500Mhz
 - d. Maximum Signal Attenuation Per 328-feet (100 meters)

2.1dB @ 1Mhz
3.8dB @ 4Mhz
5.9dB @ 10Mhz
7.5dB @ 16Mhz
8.4dB @ 20Mhz
10.5dB @ 31.25Mhz
15.0dB @ 62.5Mhz

19.1dB @ 100Mhz
27.6dB @ 200Mhz
31.1dB @ 250Mhz
34.3dB @ 300Mhz
40.1dB @ 400Mhz
45.3dB @ 500Mhz

- e. Mutual Maximum Capacitance of Any Pair 4.4nF/100m
- f. Worst Pair "NEXT" Loss Per/328-feet (100 meters)
 - 67.0dB @ 1Mhz
 - 67.0dB @ 4Mhz
 - 67.0dB @ 10Mhz
 - 67.0dB @ 16Mhz
 - 67.0dB @ 20Mhz
 - 67.0dB @ 31.25Mhz
 - 65.6dB @ 62.5Mhz
 - 42.3dB @ 100Mhz
 - 58.0dB @ 200Mhz
 - 56.5dB @ 250Mhz
 - 55.3dB @ 300Mhz
 - 53.5dB @ 400Mhz
 - 52.0dB @ 500Mhz

- 3. ScTP, all the wires in the cable shall be enclosed in a common, 100% metallic foil shield with copper "drain" wire, shield and drain wire located under the cable jacket.

2.03 COPPER WIRE CABLES (COAXIAL)

A. General

- 1. An overall non-conductive jacket shall encase the copper wires and shielding.
- 2. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA Requirements for each installation location shown. ETL tested and certified to comply with or exceed Specified Requirements. In addition to the UL Listing Requirements for Copper wire Cables twisted pair, coaxial cable shall additionally be UL listed and labeled for each install location.
 - a. NEC - CATVP (Plenum type locations and locations where not continuously enclosed inside conduit).
 - b. NEC - CATVR (Vertical riser type locations).
 - c. NEC - CATV (Locations where continuously enclosed inside conduit).
 - d. ANSI/TIA/EIA-568C; including related Standards, Amendments and TSB.
- 3. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled "Limited Combustible Cable" (LC or LCC) and shall comply with the latest published revision of all of the following Additional Requirements.
 - a. Limited combustible "FHC-25/50" per UL-2424.

- b. NEC/CEC; CMP, additional listing/labeling where the install location is an environmental air plenum, "FHC-25/50-CMP".
 - c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.
 - d. NFPA-5000; defines combustible material including wire and cable.
 - e. NFPA-75 computer rooms and electronic equipment room.
 - f. NFPA-13; spaces containing "limited combustible loading".
4. Cables shall qualify as 100% recyclable materials disposal, RoHS Regulation complaint.
 5. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number and Agency (AHJ) listing identification.
 6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall be UL listed and labeled for installation in air plenums.
 7. Cables installed in raceways or conduits below grade, through in-grade manholes and pullboxes shall be rated for installation in water/wet locations.
 8. Copper wire Electronic Network Systems Infrastructure cable shall be product of the same Manufacturer, including portable patch cables.
- B. RG6 Coaxial Cables
1. ANSI/TIA/EIA-568C cables. RG-6, Quad-Shield cables, shall be tested and shall pass ANSI/TIA/EIA test recommendations for the cable type. Rated for both analog and digital RF signal circuits.
 2. Operational characteristics:
 - a. Single center conductor size 18AWG stranded or solid bare copper.
 - b. Velocity of propagation not less than 82%.
 - c. Impedance 75-OHM.
 - d. Maximum signal attenuation per 100-feet.

▪ Baseband Video	0.26dB @ 1MHz
▪ Upstream Digital Cable	0.76dB @ 10MHz
▪ TV ch. 2	1.46dB @ 50MHz
▪ FM Radio	2.05dB @ 100MHz
▪ TV Ch. 12	2.83dB @ 200MHz
▪ CATV Ch. 54	4.05dB @ 400MHz
▪ CATV Ch. 109	5.60dB @ 700MHz
▪ CATV Ch. 142	6.23dB @ 900MHz
▪ DBS	6.59dB @ 1000MHz
▪ DBS	7.50dB @ 1200MHz
▪ DBS	8.04dB @ 1450MHz
▪ PCS Cell Phones	8.50dB @ 1800MHz
▪ Wireless Cable	9.00dB @ 2200MHz
▪ High Frequency	13.7dB @ 3000-4500MHz
 - e. Capacitance 16.2 pf/feet
 - f. ASTM-D4566, 5 thru 4500MHz Return Loss Headroom (RLH) not less than 20dB.
 - g. 100% sweep tested 5MHz thru 4500MHz

3. Four alternating layers of metal foil shielding and brass braiding shielding, 100% metallic shielding below the jacket and symmetrically enclosing the individual layers of dielectric insulation surrounding the center conductors.

2.04 FIBER OPTIC FIBER SPLICES

A. General

1. Fiber optic cable splices shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
2. Fiber optic splices shall be the product of the same Manufacturer.

B. Mechanical Splice

1. Mechanically splice each fiber with a splice suitable for use with the type of fiber optic fibers. Re-enterable and reusable splice. Splice shall be recommended as compatible with the optical fibers by the Manufacturer. Splice shall not require the use of adhesives. Splice shall provide integral strain relief.
2. Performance Requirements after installation:
 - a. Operating temperature range minus 20-degrees centigrade through plus 60-degrees centigrade.
 - b. Loss variation over temperature range, 0.05dB or less at specified wave lengths.
 - c. Insertion loss, 0.3dB or less at specified cable wave lengths.
 - d. Reflection (return loss), -40dB at specified cable wavelengths.

C. Fusion Splicing

1. Fusion splicing shall be performed with equipment providing the following features:
 - a. Cleaving and cleaning optical fiber.
 - b. Integral splice optimization verification system with local injection and detection.
 - c. Projection screen optics and fiber core alignment system.
 - d. Fiber cleaning/stripping.
 - e. Cleaning fiber ends and fusing of fiber together with an electric arc.
2. Fusion splice insertion loss as measured at the completion of the splice shall be less than 0.1dB at specified cable wave lengths.

2.05 FIBER OPTIC FIBER CONNECTORS AND INTERCONNECTION COUPLERS

A. General

1. The connectors and interconnection couplers shall be compatible, maintain the same Performance Category rating and be compatible with the corresponding fiber optic cable type attached to the connectors.
2. Fiber optic cable connectors and interconnection couplers shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. Connectors and couplers shall comply with ANSI/TIA/EIA-568C, related Standards, Amendments, TSB, and TIA/EIA-Fiber Optic Connector Intermateability Standard (FOCIS) documentation.
3. Fiber optic connectors and couplers shall be the product of the same Manufacturer.

4. Shall be UL listed and comply with UL94V-0.
 5. Color code connectors for fiber optic cables to match the respective fiber optic strand/jacket color.
- B. Fiber Optic Fiber Connectors
1. LC – Small Form Factor (SFF) termination connector
 - a. Ceramic oxide 1.25mm ferrule. Mechanical durability not less than 500-mating cycles. Insertion loss of mated connector shall be less than 0.3dB at specified wavelengths.
 - b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide duct cover cap for each connector.
 - c. Locking type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.
 2. ST type bayonet termination connector
 - a. Ceramic aluminum oxide 2.5mm ferrule, multi-cure ultra violet or heat cured epoxy bonded, for multimode or single mode to match cable fiber. Insertion loss of each mated connector shall be less than 0.3dB at specified wavelengths.
 - b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide dust cover cap for each connector.
 - c. Locking type, to automatically align fiber cable and prevent accidental pullout.
 3. SC – Square/Subscriber termination connector
 - a. Ceramic oxide 2.5mm ferrule.
Insertion loss of mated connectors shall be less than 0.3dB at specified wavelength.
 - b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match connector installation application. Provide dust cover cap for each connector.
 - c. Push-pull snap and lock type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.
 4. "FSD" fixed shroud duplex type termination connector
- C. FIBER OPTIC FIBER INTERCONNECTION COUPLERS
1. Interconnection couplers shall be "like-to-like" compatible, and shall provide "plug-in" coupling of two fiber optic cable connectors terminated with fiber optic fibers front-to-rear "in-line" together. The coupler shall provide interlocking, automatic optical self-alignment of two mating fiber optic connectors.
 2. The centerline to centerline spacing of the interconnection couplers shall allow removal and insertion of portable patch cords, fiber cable connectors for both "single" and "duplex" type fiber adapter connectors without interfering with adjacent connectors.
 3. Patch panel mounted interconnections couplers shall be factory pre-mounted to a modular nominal 0.09-inch thick metal panel, couplers aligned and anchored on the plate.
 - a. The metal panel shall be predrilled for standard EIA mounting in high-density 19-inch wide metal patch panel frames.

4. Interconnection couplers in workstation outlets shall be installed in outlet boxes with cover plates.
5. Provide removable dust caps for the front side of each coupler.

2.06 COPPER WIRE OUTLET CONNECTORS

A. General

1. Connectors shall comply with FCC part-68 Subpart F for gold plating.
2. Connectors shall be UL listed and shall comply with UL94V-0.
3. Provide a removable blank dust cover for each plug-in outlet insert. The dust cover shall protect the insert from contamination until a workstation or patch cord is "plugged" into the outlet.
4. Copper wire outlet connectors shall be color coded to distinguish telephone/ voice separately from computer/data. The outlet cover plate shall be engraved to identify telephone/voice, computer/data and other infrastructure outlets separately.
5. Copper wire outlet connectors shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
6. Copper wire outlet connectors shall be the product of the same Manufacturer.

B. Universal Outlet Connector (for twisted pair Copper Wire Premise/Workstation Wiring and copper wire patch panels).

1. General

- a. Connections for twisted pairs copper conductors shall provide a universal outlet connector between the building premise copper wire, and plug-in workstation locations. Patch panel/ equipment plug-in connectors. The connector components shall assemble with "snap-in" spring loaded retainers to prevent dislocation during insertion or removal of external plug-in devices.
- b. The contacts shall be gold plated with a 250 insertion/withdrawal cycle rating.
- c. Unless specifically noted otherwise the universal outlet connector shall comply with ANSI/TIA/ EIA-568C; related Standards, Amendments and TSB.
- d. Operational characteristics shall match or exceed and shall be compatible with the respective twisted pair's cable.
- e. A metal ground shield with EMI/RFI metal ground clip shall be provided where shielded cable is connected to the universal outlet connector for each universal outlet connector assembly.
- f. Each universal outlet connector shall consist of three major components.
 - 1) Universal edge connector assembly.
 - 2) Plug-in adapter inserts.
 - 3) Connector housing.
- g. Provide snap-in blank removable insert covers for connector installed without plug-in adapter inserts.

2. Universal edge connector:

- a. Insulated assembly shall connect to the premise copper wire. The connectors shall be multiple plug type connector contacts, one contact (total of eight contacts) for

- each individual premise wire connection interconnected to the individual wire terminations.
- b. Connector shall provide insertion of individual insulated copper wire, gas tight, 110-style punch down/displacement termination, for 22-26 AWG insulated premise wire.
 - c. The edge connector assembly shall provide termination of eight separate wire conductors, twisted or untwisted pairs, solid or stranded, shielded or unshielded, with color codes and numbered identification of each contact. Integral cable/conductor strain relief to prevent pullout of terminated premise wire conductors.
3. Plug-in adapter inserts:
- a. Plug-in adapter inserts shall be internally factory connected to the universal edge connector assembly to adapt the universal connector to the specific outlet type configuration (i.e. "RJ" style computer/data, telephone/voice, (multimedia) modular jacks, etc.).
 - b. Inserts shall be certified for shielded or unshielded wire, to match premise wire type connected to the universal edge connector.
 - c. Inserts shall provide correct pin-to-pin connections, electrical and mechanical matching characteristics for the specific equipment connected to the respective outlet.
 - d. Inserts for different infrastructures shall be color coded with different colors from each other, for system identifications.
 - e. Plug-in adapter insert type:
 - 1) Computer/data network systems:
 - a) ANSI/TIA/EIA-568C, female modular jack 8-position/contact "RJ-45" style.
 - 2) Telephone/intercom voice systems:
 - a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45" style.
 - 3) Multimedia audio/video tv (baseband only):
 - a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
 - b) Each multimedia audio/video outlet location provides a Balun to match the circuit impedance of the premise wiring to the multimedia outlet signal type.
 - 4) Intrusion detection/access control systems:
 - a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
 - b) Each intrusion detection system outlet location provides a Balun to match the circuit impedance of the premise wiring to the intrusion system outlet signal type.
4. Connector housing:
- a. Connector housing shall contain the universal edge connector assembly and the plug-in adapter inserts in a rigid assembly. Connector housing shall provide integral cable strain relief for the premise wiring connection.
 - b. The connector housing shall mount to a metal panel, metal device cover plate or plastic device cover plate with spring loaded snap-in retainers. Nominal depth of connector housing behind the mounting panel and/or device cover plate shall not exceed 1.625-inch including Premise Wiring Termination Depth Requirements.

C. Coaxial Cable Connectors

1. General
 - a. BNC type connectors, for coaxial cable premise/workstation wiring and coaxial cable patch panel equipment.
 - b. Unless noted otherwise, the BNC connectors shall comply with ANSI/TIA/EIA-568C and related standards, addendums and TSB.
 - c. Brass body and male contact. Beryllium copper or bronze female contact. Bayonet coupling with threaded or cam-locking mating connection.
2. Operational characteristics shall match or exceed and shall be compatible with the respective coaxial cable. 75-OHM, operational frequency range 0-4500MHz.

2.07 FIBER OPTIC FIBER DISTRIBUTION ENCLOSURES

A. General

1. Fiber optic fiber distribution enclosures shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
2. Fiber optic fiber distribution enclosures shall be the product of the same Manufacturer.

B. Equipment Rack Mount Fiber Optic Termination Distribution Enclosure - RTDE

1. The RTDE enclosure shall mount in an EIA Standard 19-inch wide enclosed or open frame equipment rack assembly. The RTDE enclosure shall be metal, painted finish, Manufacturers standard color.
2. The RTDE shall provide the following self-contained functions internal to the RTDE assembly.
 - a. Fiber cable termination.
 - b. Fiber cable "pig-tail" splicing.
 - c. Fiber cable patch panel.
 - d. Fiber cable management, training and strain relief.
 - e. Individual fiber and patching port identification numbers, color-coding of incoming trunk and out-going distribution fiber ports.
 - f. Plug-in fiber optic interconnection couplers for port to port patching with portable fiber optic patch cords.
3. Fiber splice drawers:
 - a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open, and removable for easy access. Each drawer shall contain two fiber optic splice trays with tray holders.
 - b. Drawers shall stack vertically one above the other in the RTDE and allow sufficient slack in all fiber cables for removal of the drawer and splice trays.
 - c. Provide one sliding drawer and two splice tray assemblies for each group (24-individual fibers or fewer fibers per group) of fiber optic fibers terminated in the equipment rack, but in no case provide not fewer than two sliding drawers with splice tray assemblies in each RTDE.

4. Fiber cable patch panel
 - a. Metal panel shall provide a patch port for each fiber consisting of metal panel mounted fiber optic interconnection couplers for each fiber optic fiber indicated to be terminated at the RTDE.
 - b. The fiber optic fiber interconnection coupler shall be provided to match and be compatible with the fiber cable connectors. Quantity shall match quantity of terminated fibers, unless indicated otherwise on the equipment rack schedules.
 - c. Nominal panel thickness 0.09 inches.
 - d. Provide a minimum of sixteen unused spaces for additional couplers in the patch panel.

5. Nominal height of the RTDE shall not be exceeded, as follows:

<u>Quantity of Patch Ports</u>	<u>Quantity of Splice Drawers</u>	<u>Nominal Height</u>
24	2	11-inches
48	2	11-inches
72	3	14-inches
144	6	28-inches

C. Equipment Rack Mount Fiber Optic, Splice only (for use only where fiber patch panel is not required) enclosure - RMSE

1. The RMSE enclosure shall mount in an EIA standard 19 inch wide enclosed or open frame rack assembly. The enclosure shall be metal, painted finish, Manufacturer's standard color.
2. The RMSE shall provide the following self-contained functions internal to the RMSE assembly:
 - a. Fiber cable splicing for "thru splicing" of fiber optic cables where the cables do not terminate in the equipment rack.
 - b. Fiber cable management, training and strain relief.
3. Fiber splice drawers
 - a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open and removable for easy access. Each drawer shall contain two fiber optic splice trays with splice tray holders.
 - b. Drawers shall stack vertically one above the other in the RMSE and allow sufficient slack in all fiber cables for removal of the drawers and splice trays.
 - c. Provide one sliding drawer and two fiber optic splice tray assemblies for each group (24-individual fibers or fewer fibers per group) for fibers optic fiber routed through but not terminated in the equipment rack, but in any condition provide not fewer than two sliding drawers with splice tray assemblies in each RMSE.
4. Nominal height of the RMSE shall not be exceeded, as follows:

<u>Quantity of Thru Splices</u>	<u>Quantity of Splice Drawers</u>	<u>Nominal Height</u>
24	2	4-inches
48	2	4-inches
72	4	8-inches
96	4	8-inches

2.08 COPPER WIRE PATCH PANELS

A. General

1. Copper wire patch panels shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
2. Copper wire patch panels shall be the product of the same Manufacturer.

B. Equipment Rack Mounted Patch Panel

1. Standard EIA 19-inch wide metal panel, Manufacturers standard color. Prepunched for copper wire outlet connectors. Panel shall mount on an EIA standard 19 inch wide enclosed or open frame equipment rack assembly. Nominal 24-copper wire outlet connectors in a horizontal row, quantity of rows as required for total quantity of connectors. Provide not less than two spare empty rows for future copper wire outlet connectors.
2. The patch panel shall provide the following self-contained functions.
 - a. Copper wire cable termination including conductor/ shield termination and strain relief.
 - b. Plug-in copper wire outlet connectors for port to port patching with copper wire portable patch cords.
3. Patch panel height shall be based on the quantity of copper wire outlet connectors described plus the specified space for future outlets and shall not exceed the following dimension height:

<u>Outlet Quantity</u>	<u>Nominal Patch Panel Height</u>
1-24	3.5 inches
25-48	7 inches
49-72	10.5 inches
73-96	14 inches

4. Horizontally mounted, cable support metal bracket shall be provided for each 24-outlet/connector groupings. The brackets shall be bolted to the equipment rack located at the backside of the patch panel; the brackets shall support and provide strain relief for each incoming copper wire cable connecting to the patch panel.
5. The copper wire connector installed in the patch panel shall be the same configuration, Manufacturer and type as the corresponding copper wire connector provided in the remote workstation outlet locations connecting to the respective patch panel outlet, unless indicated otherwise.
6. Each multimedia, audio/video/TV multimedia and intrusion detection/access control outlet. Provide a Balun, to match the circuit impedance of the premise wiring and to the outlet signal type.

2.09 TELEPHONE/VOICE TERMINAL BLOCKS

A. General

1. Terminal blocks Type 110, shall consist of wiring blocks, connecting blocks, direct wire/patch cord cross connection and designation strips. Arrange in unitized, modular, vertical mounting sections, for telephone/voice.

2. Completely 100% front accessible for cross connections, terminating conductors, training, and fanning of cables. Rear access for any reason shall not be permitted.
3. Telephone/voice terminal blocks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. Telephone terminal blocks and connections performance shall comply with ANSI/TIA/EIA - 568C and related Standards, Addendums and TSB and shall comply with and be listed under UL 1863. Category rating shall match the cables connecting to the patch panel.
4. The telephone/voice terminal blocks shall provide cross connection of telephone/voice four pair premise copper wiring from telephone/voice handset outlets to multiple copper wire telephone/voice feeder cables and external free standing telephone equipment.
5. Each full height vertical section terminal block assembly shall terminate a minimum of 900 pairs (including specified spares for future construction phases) of telephone/voice conductors, plus associated cross connection wiring and patch cords in a nominal 20-inches wide by 90-inches high space. Provide multiple vertical sections of terminal block assemblies adjacent to each other, total quantity as required for quantity of telephone/voice conductor pairs and telephone/voice feeder cable pairs shown on the Drawings and Requirements, plus specified spares.
6. Each telephone/voice terminal block vertical section assembly shall provide 15% or 100 (whichever is the larger quantity) of spare unused conductor pair terminals for future telephone/voice connections.
7. Provide a common ground bus in each terminal block section with a minimum of six ground conductor termination positions, #10AWG through #6AWG.
8. Terminal blocks shall be the product of the same Manufacturer.

B. Wiring Blocks

1. One piece molded, die-electric thermoplastic blocks. The wiring block shall support and secure all the components of the terminal block assembly, and provide cable/conductor training and organization.
2. Fire retardant complying with UL 94V-0.
3. Standoff type support legs for mounting to backboard with pre-drilled anchor holes.
4. Non-conductive electrically quiet front assembly.
5. Horizontal index strip rows, for termination of not less than 25-conductor pairs on each row. Color coded and marked in groups of four pairs or five pairs to match connecting cables.
6. Removable retainers at the ends of each horizontal connecting block index strip row, shall support cross connect wires at corner turns.
7. Distribution rings shall retain cross connect wire horizontal routing between terminations.
8. A full width, horizontal trough between each 100 pair wiring block shall provide a path for patch cord training and retention.

C. Connecting Blocks

1. Connecting blocks shall provide gas tight conductor electrical connections with conductor insulation displacement punch down slots, for insertion onto the telephone/voice wiring block index strips.
2. Connecting blocks shall electrically connect one-to-one between each conductor terminated at the wiring block index strips, and each cross connect/patch cord conductor terminated/connected to the opposite front side of the connecting block.
3. Both sides of the connecting blocks shall terminate telephone/voice UTP 22-26AWG stranded or solid copper wire individually insulated conductors. The front side of the connecting blocks shall also provide "plug-in" connections for portable patch cords, 110 style "plug-in" connectors.
4. Connection blocks shall be 4-pair insulated copper conductor type.
5. Provide insulated, removable termination caps for each connector block.
6. Connector blocks shall be marked to indicate tip and ring conductors and to indicate polarization.

D. Designation Strips

1. Designation strips shall provide retention of interchangeable labels. The labels shall show circuit identification of each terminated conductor pair.
2. The designation strips shall mount on the center and outside positions of the wiring block.

E. Telephone/Voice Cross Connection

1. The cross circuit connection between incoming and outgoing feeder cables and telephone voice outlet wiring shall be provided in the terminal block assembly.
2. The cross connection wiring shall terminate incoming and outgoing circuit conductors between respective connecting blocks.
 - a. Direct connect cross connection shall provide internally wired one-to-one conductor twisted pair cross connection. Provide cross connection of each 4-pair telephone/voice outlet cable to corresponding 4-pairs of the telephone/voice feeder cable and cross connection of feeder to feeder cables, as applicable.
 - b. Patch panel cross connect, 110-terminal connector style, plug-in. Provide two twisted pair, 110-connector type portable patch cords.
 - c. Prewired 50 pin-Amphenol connectors:
 - 1) Provide factory prewired 50-pin Amphenol connectors for connection from telephone/voice terminal blocks to the telephone switch equipment and Telephone Utility Company outside telephone service lines.
 - 2) Provide 50-pair ANSI/TIA/EIA-568C and related Standards, Addendums and TSB cables, connected to 50-pin Amphenol connectors at one end (telephone equipment connection) and connected to the respective telephone/voice terminal wiring blocks at the other end.
 - 3) The 50 pin Amphenol connectors shall group together and be positioned at the top of the respective terminal block section near the ceiling.
 - 4) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's Requirements.

- 5) The Amphenol connector/cable assemblies shall connect to and extend the telephone/voice outlet premise wiring from telephone/ voice terminal block to the telephone switch equipment. The Amphenol connector/cable assembly shall connect to and extend the Telephone Utility Company outside telephone service lines to the telephone switch equipment.
- d. Prewired "RJ" style modular jacks
 - 1) Provide factory prewired eight position/contact plug-in "RJ" style jacks for patch panel portable patch cord cross connects, located on the front side of the terminal blocks.
 - 2) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's Requirements.

2.10 EQUIPMENT RACK

A. General

1. An equipment grounding bus, nominal 19-inches long, UL labeled as a ground terminal bus, shall be provided on each equipment rack. The ground bus shall be bolted to the rack main metal frame member with 1-inch standoff non-insulating bolts. Provide a minimum of ten drilled and taped bolt holes in the ground bus with ground lug bolts, for connection of equipment grounding conductors to the ground bus, size to accept ground conductors #14-#4AWG.
2. Vertically mounted, cable management metal rings (aluminum or stainless steel) shall be provided full height, continuously along the front and rear of each vertical rail of the equipment rack. The rings shall be bolted to the equipment rack. The rings shall train and dress portable patch cords connecting between outlet connectors located in the equipment rack or in adjacent equipment racks.
3. Provide horizontal cable management panels with multiple cable training rings on each panel (not less than five rings for each panel). Management panels (for up to 24-outlet grouping) nominal 19-inches wide by 1.75-inches high by 3-inches deep and/or (for up to 48-outlet groupings) 3.5-inches high by 3 inches deep, for EIA rack installation. Rings shall provide horizontal routing and support by grouping portable patch cords connecting between patch ports in the same equipment rack or adjacent racks. Patch cords shall be grouped and bundled with "Velcro" tie wraps and shall not overlap patch fields or rack mounted equipment.

The cable management panels shall be installed on both the front and rear of the equipment racks mounted both above and below horizontally between groups of patch ports as follows:

- a. One cable management panel (front and rear of rack) for each group of forty-eight or less copper wire outlets for patch ports.
- b. One cable management panel (front and rear of rack) for each group of 48-fiber optic outlet patch ports.
4. The entire rack assembly including any support arms shall comply with Seismic Earthquake Requirements for install location Structural Standards.
 - a. The assembly shall provide support for the weight of the equipment installed on the rack, but in no case less than 500-pounds of equipment, plus the weight of the rack

and connecting cables. A 2.0 time's safety factor shall be included in the equipment rack assembly structural design.

5. Provide plug strip Surge Protection Device with RF Suppressor (SPD) and Power Distribution Units (PDU). Horizontal strip, mounted in each equipment rack. Each unit shall contain not less than six "plug-in" on the rear of the SPD and not less than two plug-in on the front of the SPD protected outlet plugs.
 - a. Provide two SPD/PDU units in each equipment rack, to supply "dual-corded" equipment.
 6. Provide pre-drilled mounting holes the entire length of equipment vertical mounting frames, EIA-310D-19 inch (nominal) wide standard spacing for indicated equipment. Racks shall provide 17.75-inches (nominal) equipment horizontal mounting space between vertical rails.
 7. Provide all floor standing equipment racks with wall bracket support arms extending from the stationary portion of the rack to adjacent wall. Provide "dual-rail arm" cable "runway tray", horizontally from each equipment rack, to the wall directly behind the equipment rack
 - a. The tray shall extend from and bolt to the top of the equipment rack "fixed" top rail.
 - b. The tray side rail arms shall be a minimum of 6-inches deep, with "ladder" type rungs spanning horizontally between the side rail arms. The rail arms shall be parallel with each other. The rail-to-rail arm spacing shall be the same as the equipment rack width.
 - c. The rungs shall be spaced not more than 6-inches on center between the side rails, along the length of the side rail arms. The rungs shall have a minimum cable-bearing surface of not less than 0.75-inches, lengthwise along the tray.
 - d. The runway tray shall support a minimum of 200 pounds per linear foot live conductor/cable loading, with not more than 0.25-inches deflection at mid-span.
 - e. Provide a continuous horizontal support "C" channel along the wall behind the equipment racks and bolt the dual-rail arm cable runway tray to the channel at the wall. The channel elevation on the wall above the finish floor shall support the runway tray horizontally (± 0.2 -inches), from the equipment rack to the wall.
 - f. Equipment racks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
 - g. The wall mounted horizontal support channel shall be securely through bolt to wall structural member, a minimum of 16-inches on center. The horizontal support channel shall extend a minimum of 6-inches past each side of the runway tray. Support channels as manufactured by Unistrut-P1001C Series; or B-Line; or Kindorf.
 8. Provide a copper ground – bus for equipment bonding, in each equipment rack.
 9. Equipment racks shall be Manufacturer's standard rust inhibitor primer. Manufacturer's standard color finish paint over primer, unless noted otherwise.
- B. Swing Gate Open Equipment Rack Style:
1. Combination wall and floor mounted rack frame nominal 78-inches of usable equipment vertical space for mounting equipment into the rack. The equipment mounting portion of the rack shall be a hinged gate frame assembly. The rack shall provide access to the

rear of the installed equipment, the wall behind the rack assembly and wall mounted terminal blocks, when hinged open.

2. The gate assembly shall hinge open not less than 90 degrees from the closed (normal position) on a fixed frame combination floor/wall mounted support structure. A positive latching mechanism shall lock the gate in the fully open and fully closed positions. The rack construction shall allow opening the swing gate, with the installed equipment depth, without obstruction. The fixed stationary portion of the swing gate rack assembly shall be supported from both the fixed floor bracket and wall located behind the rack with adjustable length "dual rail arm" wall brackets. The arms shall provide field adjustment (approximately 24-inches) of the equipment rack spacing from the wall behind the rack. Provide a minimum of two support arms for each swing gate equipment rack.
 3. The rack assembly shall be constructed of extruded metal; aluminum gold irradiates finish, or hot dip galvanized steel. Bolted or welded assembly. Hardware shall be stainless steel.
 4. Provide steel caster rolling wheel support on the bottom rail of the moveable swing gate frame. The wheel shall provide additional support, but not the main support, of the moving gate assembly and rack mounted equipment along the floor travel "outside arc" of the gate in the open or closed position. The vertical height of the wheel assembly shall be adjustable ± 3 inches.
 5. Swing gate equipment racks as manufactured by B-Line; or Saunders; or Hendry.
- C. Floor Standing Equipment Rack Fully Metal Enclosed Style:
1. Floor mounted self-supporting rack, nominal 80-inches high by 24-inches deep, by 24-inches wide. Internal bolted or welded hot dip galvanized steel or gold irradiate finish aluminum, support frame. Metal enclosed with screw attached removable metal panels. Manufacturer's standard finish color.
 2. The front and rear of the rack shall be a full height hinged door, opening not less than 90 degrees from the closed position. The doors shall be readily removable with positive latching mechanism to lock to the doors in fully open or fully closed positions. Doors shall be pad-lockable. Rack shall provide a minimum of 4-inches of clear space between front door and internal mounting face for rack mounted equipment. Smoke/grey impact resistant, tamper resistant see-through windows in the doors, front and rear. Hardware shall be stainless steel.
 3. Provide six 120-volt 60Hz AC motor direct drive air ventilation, "muffin" style, nominal 4-inches square, exhaust air fans. Flush mount fans in the top of each equipment rack. The fans shall be low speed, low noise type with wire guards to prevent accidental contact with the fan blades. The fan motor shall be high impedance, self-protecting type motors. Provide "SO" cord with plug caps to connect from the fans to the 120 volt plug-strip in the equipment rack.
 4. Provide cooling air intake louver with a removable 19-inches wide air filter and air filter holder, mounted in the bottom of the rack front nominal 6-inches high.
 5. Floor standing metal enclosed equipment racks as manufactured by Stantron; or BUD; or equal.

- D. Fixed Position Floor Standing Open Frame Equipment Racks:
1. Floor mounted self-supporting rack, nominal 78-inches of usable mounting frame height for equipment.
 2. Bolted or welded hot dip galvanized steel or gold irradiate finish aluminum support frame. Hardware shall be stainless steel.
 3. Open frame rack construction, fixed, non-swing gate.
 - a. "Two-post" style for equipment racks not designated as containing UPS equipment nor server equipment.
 - b. "Four-post" style for equipment racks designated as containing UPS equipment and/or server equipment.
 4. Open frame equipment racks as manufactured by B-Line; or Saunders; or Hendry.
- E. Floor Standing Modular Frame Equipment Racks
1. Provide a modular frame equipment rack, bolt together modular rack system with all accessories for a completely assembled equipment rack unit. The rack system, when configured for specific equipment, shall support and organize network servers, keyboards, printers, tape drive units, RAID units, CRT's, UPS units, telephone switching equipment, desk top work spaces, etc.
 2. Nominal overall dimensions 31-inches deep by 72-inches wide by 84-inches high. Left/right or right/left orientation as indicated on Drawings. Minimum weight capacity of the entire rack assembly shall be 1500 pounds.
 3. Manufacturer's standard finish painting, crème white color for metal surfaces. Horizontal flat support surfaces shall be post-formed, laminate top finish, white color.
 4. "8L-01/8L-02" vertical support upright assemblies; shall be slotted the full height to "hook-on", lock in and support adjustable height (in 1-inch increments), modular components, with integral floor support "feet". Open back frame - "LF31". Minimum of three vertical support and open back frames in each complete assembly.
 5. Provide vertical (on upright supports) and horizontal (on modular "hook-on" components) wire management raceways integral to the assembly.
 6. Network server configuration - equipment rack unit:
 - a. "LE28" computer tower "roll-out" horizontal floor shelf; nominal 47-inches wide by 24-inches deep. Shelf shall pull out on "ball-bearing" rails, with 23-inch extension for access to computers. Provide one tower shelf for rack unit. Minimum weight capacity 750 pounds. Mount at floor.
 - b. "LE25"-computer tower horizontal shelf with ± 12 inch end panels and two shelf support brackets; nominal 47-inches wide by 22-inches deep, fixed mounted. Provide one tower shelf for rack unit. Minimum weight capacity 500 pounds. Mounting height ± 30 -inches.
 - c. "LB32" horizontal work surface; nominal 24-inches wide by 27-inches deep. Provide one work surface assembly for each rack unit. Minimum weight capacity 300 pounds. Install on left or right side of rack as shown on Drawings. Mounting height ± 28 -inches.

- d. LF10/LF11/W162 - General equipment shelf; nominal 72-inches wide by 15-inches high by 16.7 inches deep, with two horizontal shelf surfaces, full width of rack, ± 10 -inches nominal vertical height between shelves and five vertical shelf dividers. Minimum weight capacity 300 pounds. Provide one general equipment shelf assembly for each rack unit. Mount at top of rack.
 - e. "LA-09" - Keyboard platform. Retractable keyboard platform with auxiliary mouse pad and up-down 15 degree adjustable tilt and adjustable 360 degree swivel. Nominal 23-inches wide by 11 inches deep. Provide three keyboard platforms for each rack unit. Install below, upper tower computer shelf and work surface.
- F. Plug Strip Surge Protection Device (SPD).
- 1. General
 - a. Self-contained unit combining plug-in receptacle strip and SPD. Rated 20-amp, nominal 120-volt +10%, 60Hz, AC, 2400 watts full continuous load. Internal 20-amp resettable overload protection circuit breaker. Red illuminated on-off switch. 9-foot, 12AWG three-conductor grounded, high abuse heavy duty jacketed AC, line cord with NEMA 5-20P cap.
 - b. Multi-outlet receptacles, suitable for use with the following types of plug in loads; data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and "switching type" power supplies.
 - c. Protected 120-volt outlets shall be NEMA 5-15R 15-amp, or 20-amp NEMA 5-20R AC 60Hz receptacles, as applicable for connected equipment loads. Provide not less than eight protected outlet plugs on each unit. Each individual or group of two receptacles (duplex) shall be connected to separate protected load isolated filter banks.
 - d. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.
 - e. Non-blocking plug-in locations/orientation, for plug-in self-contained "power-brick", equipment power supplies.
 - f. As manufactured by Liebert; or TRIPP LITE.
 - 2. Operation

Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply over current protected and filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, transient voltage surge and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground rated as follows:

 - a. 13,000 amp, 210 joules (watt-seconds) peak withstands capacity.
 - b. Transient response time less than 5-nano seconds.
 - c. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.
 - d. RFI and EMI Suppression-Provide spectrum analysis test dB attenuation reports showing RFI filtering over specified frequencies.
 - e. Diagnostic indicator lights located on the SPD housing shall provide alarm alert for each of the following conditions:
 - 1) Loss of AC power.

- 2) Damage, malfunction in the SPD suppression circuits.
- 3) Improper AC electrical outlet wiring.
- f. Standards Testing, Listing and Certification Compliance:
 - 1) IEEE 587 A and B compliance.
 - 2) UL 1449 surge suppressers.
 - 3) UL 1363 temporary power taps.
 - 4) UL 1283 electromagnetic interference filters.
- 3. Rack Mounted SPD
 - a. SPD units installed in equipment racks shall comply with all of the same Performance Requirements including as follows.
 - 1) EIA/TIA – Equipment rack horizontal mount style (19-inches or 24-inches as applicable).
 - 2) Minimum of two front mounted outlets and not less than six rear mounted outlets.
 - 3) Position in each equipment rack as directed by Owner’s Representative.
 - 4) Provide two SPD units in each equipment rack, for “dual-corded” network equipment.
- G. Power Distribution Unit (PDU)
 - 1. General
 - a. Self-contained unit combining main circuit breaker, multiple plug-in individual circuit breaker branch protection load receptacles, PDU metering status monitoring and network communication. All PDU components self-contained in a NEMA-1 metal enclosure.
 - b. Non-blocking plug-in locations oriented for plug-in self-contained “power-brick” equipment supplies.
 - c. Standards Testing
 - 1) UL 60950-1 Information Technology Equipment.
 - 2) CAN/CSA-C22.2 No.60950-1-03 Information Technology Equipment.
 - 3) FCC, Title 47, Part 15 Subpart B for Class B operation as defined by ANSI Standard C63.4.
 - 4) ROHS Complaint.
 - 5) ISTA Procedure 1A and 2A.
 - d. Provide two PDU units in each equipment rack, to supply two SPD units in each equipment rack.
 - e. Shall be a product of the same Manufacturer as the SPD unit. As manufactured by Liebert; or TRIPP LITE.
 - 2. System Description
 - a. Remote monitoring and/or control capabilities for power distribution at each load/ equipment rack level. For data/network equipment line voltage plug-in and SPD line voltage plug-in electrical distribution.
 - b. PDU shall meter and monitor electrical attributes of an individual Rack PDU, including real-time remote and local display of monitoring of aggregate and branch electrical parameters (status, thresholds, alarms) including voltage, ampere, and kW. Rack equipment PDU and Branch load monitoring and control.

- c. Self-contained metering and communications
 - 1) Local display ampere-meter demand load meter to monitor plug-in demand load and total PDU load.
 - 2) Digital Fast Ethernet LAN RJ-45 communications port for Ethernet SNMP and IP network monitoring of electrical status. Multi-user site-wide software license, compatible with PC-computer and IP-WEB HTTP protocols.
 - 3) Provide network array-interface for connection of multiple PDU units positioned in the same location.
 - d. Nine foot input power (heavy duty high abuse) cord with appropriate conductors and input NEMA plug-in connection. Provide input overload protection with Hydraulic-Magnetic main input circuit breaker. Provide load output NEMA plug-in branch connection with overload circuit breaker protection for each load receptacle.
 - e. Equipment rack mounting horizontal position form factor.
3. Electrical Power ratings shall be as follows and as additionally indicated on Drawings. Refer to Drawings for twist-lock versus straight-blade configurations.
- a. Single main input circuit breaker 30 amp, 208/120 volt 3-phase 5-wire “WYE” grounded 60Hz AC.
 - b. Branch load circuit breakers with a single plug-in receptacles for each load circuit breaker. Balance loads on each circuit phase.
 - 1) Three 20 amp 1-pole circuit breaker and three NEMA 5-20R receptacles. Also provide matching caps.
 - 2) One 30-amp 2-pole circuit breaker and one (1) NEMA 14-30R receptacle. Also provide matching cap.
 - 3) Additional circuits and receptacles as indicated on Drawings.
4. Provide heavy duty high abuse flexible copper wire 300-volt insulated 15-foot long jacketed electrical cord. Connect from PDU to wall-outlet receptacle with same electrical rating as PDU. Rated for PDU voltages and amperes.
5. PDU units installed in equipment racks shall comply with all of the same Performance Requirements including:
- a. EIA/TIA – equipment rack horizontal mount style (19-inches or 24-inches) as applicable.
 - b. Position in each equipment rack as directed by Owner’s Representative.
6. Provide two Category-6A 4-pair UTP 15-foot long portable patch cable connects, PDU to respective network patch panel port.

2.12 WALL MOUNT FIBER OPTIC CABLE INTERFACE CABINET (WMIC)

A. General

- 1. Metal (14 gauge) enclosure, with full height hinged metal door. Door shall be pad-lockable. Nominal size 12-inches deep by 18-inches wide by 36-inches high. Enclosure shall mount directly on the wall.
- 2. WMIC shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
- 3. Interface cabinets shall be the product of the same Manufacturer.

- B. The WMIC shall provide the following self-contained functions internal to the WMIC enclosure.
 - 1. Fiber cable splicing for "through splicing" of non-UL listed fiber optic cables, where the cables do not terminate in the building.
 - 2. Fiber cable management, training and strain relief.
 - 3. Transition from non-UL flame spread listed fiber optic cable, to UL flame spread listed fiber optic cables where the cables terminate in the building.
- C. Cable routing rings shall organize optic fibers in a 360 degree loop inside the WMIC housing and provide cable strain relief.
- D. Fiber Optic Splice Trays
 - 1. Provide fiber optic cable splice trays.
 - 2. Tray holders shall provide mounting and support for each splice tray.
 - 3. Provide two splice trays for each group (24 or less fibers per group) fiber optic fibers routed through the WMIC, but in no case provide not less than four splice trays in the WMIC.

2.13 UNIVERSAL SPLICE ENCLOSURES - USE

- A. General
 - 1. The universal splice enclosure shall provide splicing for multiple cables containing multiple, network copper wire conductors or fiber optic fibers.
 - 2. The enclosure with the connecting cables installed shall be water tight, continuously submersible in up to 10-feet depth of water without leaking water into the enclosure interior.
 - 3. The enclosure with splices shall be completely re-enterable to allow access to the interior splices, adding cables, and removing cables, without compromising the water tight integrity of the enclosure.
 - 4. The universal splice enclosure assembly shall be UL listed.
 - 5. The USE shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
 - 6. USE shall be the product of the same Manufacturer.
- B. Fiber Optic Splices
 - 1. Provide fiber optic splice trays inside the USE. Each splice tray shall provide space for up to 12 splices in lieu of 24-splices on the tray.
 - 2. A splice tray holder shall rigidly anchor splice trays inside the USE, with sufficient slack cable, to allow individual removal of each splice tray.
 - 3. Provide one splice tray for each 12-fibers passing through the USE, but not less than eight splice trays in the use enclosure.
- C. Copper Wire Splices

2.14 SPLICE TRAY FIBER OPTIC FIBERS

A. General

1. Trays shall be suitable for installation in USE, WMIC, RMSE and RTDE enclosures.
2. The trays shall be the product of the same Manufacturer as the respective enclosures.
3. Splice trays shall be UL listed, complying with national Electrical Code, ETL tested and certified to comply with or exceed specified Requirements, ANSI/ TIA/EIA-568C including related Standards, Amendments and TSB.

B. Splice Trays

1. A metal or non-metal splice tray shall provide space for up to 24-splices of individual fiber cable single mode and multimode optical fibers. The trays shall provide individual splice holder inserts for each splice to adapt the tray for mechanical or fusion splices, with or without splice sleeves.
2. The tray shall incorporate integral fiber tie down clamps, fiber routing rings, provide strain relief and two full 360-degree fiber loops around the tray perimeter with sufficient slack fiber for removal of the tray for access and splicing of the fiber cable. The tray shall insure the minimum bending radius of the optical fibers is not violated.
3. Provide a removable clear plastic tray top cover for each tray, to protect and isolate the fibers.

2.15 WORK STATION OUTLETS

A. General

1. Engrave outlet cover plates with the port number corresponding to the port number at the respective terminal block, patch panel, or head-end equipment.
2. The outlet cover plates shall be factory pre-punched and formed to accommodate the installed outlet connector with attachment screws.
3. Workstation outlets shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
4. Workstation outlets shall be the product of the same Manufacturer.

B. Computer/Data Workstation Copper wire Outlets

1. The outlets shall be the same configuration and type as the corresponding connector provided in the copper wire patch panel outlet, unless noted otherwise.
2. ANSI/TIA/EIA-568C, and related Standards, Addendums and TSB.
3. The copper wire outlet connectors for twisted pair wire connections in computer workstation outlets shall be universal outlet connector RJ-45 type.

C. Telephone/Voice Handset Twisted Pair Wire Connection Work Station Outlets

1. The copper wire outlet connectors provided in telephone/voice handset outlets, shall be universal outlet connector type, unless noted otherwise, ANSI/TIA/EIA-568C and related Standards, Addendums and TSB.
 - a. RJ-45 type
 - b. RJ-11 type

D. Fiber Optic Workstation Outlets

1. The fiber optic outlet connectors workstation outlets shall be fiber optic fiber inter-connection couplers, installed in universal outlet connectors. Provide one coupler for each fiber connecting to the outlet, but in no case less than the following for each outlet and as shown on the Drawing:
 - a. Computer workstation data network two couplers and fiber connectors.
 - b. Data network server - four couplers and fiber connectors.
2. The universal outlet connector housing and cover plates shall be the same as copper wire outlet connectors, except with adapters for fiber optic interconnection couplers, for the fiber optic fibers plug-in connectors.
3. The centerline-to-centerline spacing of the inter-connection couplers shall provide for "plug-in" insertion of "single or duplex" fiber connectors.
4. Color-code and identify the "in"-receiving and "out"-transmitting position for each inter-connection coupler.

E. Outlet Boxes

1. General for Low Voltage Outlets Requirements
 - a. Shall be UL approved and labeled for Life-Safety Appliances.
 - b. UL listed and label for low voltage CEC/NEC class-2 wiring and devices.
 - c. Shall be adjustable to fit into the wall/ceiling and attach into the wall/ceiling thickness at each install location.
 - d. Provide cable "Strain-Relief" attachment and "Sharp-Edge" protection for each outlet cable connections.
2. Wall mounted
 - a. Flush or surface wall mounted outlet box and size as indicated on the Drawings, but in no case less than 4.69-inches by 4.69-inches by 2.125-inches deep.
 - b. Two gang wide extension ring for outlet box to extend outlet flush with finish surface, or as noted on the Drawings.
 - c. Two gang wide cover plate, or as noted on the Drawings.
3. Pedestal Mounted "Poke-Thru".
 - a. Shall combine a computer/data and a telephone/voice copper wire universal outlet connector in a duplex outlet in the pedestal/poke-thru outlet.
4. Inside flush floor boxes and other locations where indicated in the Contract Documents.
5. Low Voltage Outlets in Fire rated walls and ceilings
 - a. Provide metal outlets for low voltage devices installed (recessed into) in fire rated walls or fire rated ceilings.
 - b. Provide metal outlet box enclosed type, for each outlet location. Provide UL labeled and listed "Fire-Wrap" complete coverage protection on the exterior of each outlet box. The combined outlet box and "Fire-Wrap" protection shall be equal or greater than the respective wall or ceiling fire-rating location.
6. Low Voltage Outlets in Non-Fire Rated walls and ceilings
 - a. Outlets for low voltage devices installed (recessed into) walls or ceilings, only where the wall/ceiling is not fire-rated.

- b. Provide the following for each outlet location
 - 1) Metal outlet box, enclosed type. All locations where one or more conduit(s) are required to connect to the outlet, then only metal outlet box shall be provided.
 - 2) Or device mounting bracket with trim ring, without (backless) enclosed outlet box. Do not use bracket-trim/ring configuration where conduit connection to the outlet with conduit is required, provide metal outlet boxes. Shall provide attachment for low voltage device(s), cover plates and low voltage wire strain relief.
- 7. Low Voltage outlet installed into accessible suspended ceiling with removable ceiling panels.
 - a. Support outlet independent of ceiling supports and ceiling.
 - b. Provide a minimum of three independent hanger wires for each outlet. Attach hanger wires to building structure above ceiling and to outlet.
- 8. Low Voltage Outlets in existing walls and existing ceilings
 - a. Outlets installed (recessed into) existing walls or (recessed into) existing ceilings. Cut and patch to match existing surfaces for outlet installation.
 - b. Provide "cut-in" retrofit mounting-attachment into existing ceiling/wall construction. Shall be UL rated for retrofit into "old-work".
 - c. Provide the following for each outlet location,
 - 1) Metal outlet box, enclosed type. Required for all Fire rated construction locations. Also permitted for non-Fire rated construction locations.
 - 2) Or device mounting bracket with trim ring. Permitted only for non-Fire rated construction locations only where no conduit connection to the outlet is required. Do not use in Fire rated construction locations. Do not use where conduit connection to outlet is required.
 - d. Where the existing wall/ceiling existing fire rating is indeterminate, Contractor shall assume the existing fire rating is not less than 2-hours. Provide metal outlet box and Fire-Wrap for each recessed outlet box.
- F. Multi-outlet Raceway Work Station Outlets
 - 1. Copper wire outlet:
 - a. Where copper wire connection is indicated for the workstation outlet, provide one universal outlet connector for each outlet.
 - b. Each universal outlet connector shall be single connector housing type.
 - c. Provide a rectangular cutout and metal device plate in the raceway sized to Outlet Manufacturer's recommendations. The workstation copper wire outlet shall mount a modular faceplate kit with outlet bezel and faceplate sized to match the workstation outlet.
 - d. Offset the location of outlets for electronic network systems 6-inches in the raceway from other outlets, do not "stack" outlets one above the other in the raceway.
- G. Combination Outlets
 - 1. Infrastructure outlet connectors shown at the same location for either wall box outlet locations and floor box outlets locations.

2. The outlet connectors shall be installed in a common outlet box with a common cover plate in the respective wall location or floor location.
3. In infrastructure patch panels install the connectors in the respective patch panels.

2.16 PORTABLE PATCH CORDS

A. General

1. Provide portable patch cords for all copper wire and fiber optic cable infrastructure outlets:
 - a. For interconnecting electronic network equipment to electronic network workstation outlets.
 - b. For interconnecting equipment rack patch panel outlet patch locations with each other.
 - c. For interconnecting patch panel outlets equipment rack mounted hubs, switches, routers, telephone equipment, A/V equipment, access control and intrusion detection equipment etc.
2. Patch cords shall be factory assembled tested and certified with factory terminated plugs at each end. Field terminated portable patch cords shall not be permitted. Terminated plugs shall incorporate integral bending radius limiting molded "boots" and strain relief. Patch cord assemblies shall be rated for "heavy duty", "high-abuse" service.
3. Patch cords shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. ANSI/EIA/T1A-568C, related Standards, Addendums and TSB.
 - a. NEC - OFNG/OFN for fiber optic portable patch cords.
 - b. NEC - MPP/CMP/CMR/CMG/MPG for copper wire twisted pair portable patch cords.
 - c. NEC - CATV for coaxial cable portable patch cords.
4. Patch cords which are not installed shall be delivered to the Owner in cardboard boxes. The patch cords shall be neatly bundled and tied together. Mark each box with quantity and type of cords contained in the box.
5. Patch cords shall comply with the same Cable Communication Performance Requirements, Protocol Requirements and Testing Requirements as the respective infrastructure cables and outlets to which the patch cords are intended to be connected (plug-in). Patch cords shall be the product of the same Manufacturer.
6. The outer jacket of each portable patch cord shall be imprinted with date, Manufacturer's model and catalog number and AHJ listing identification.
7. Provide a permanent, visible, factory applied identification number on each end of each patch cord. The identification number shall be the same on each end. However, the numbers shall increase sequentially on each patch cord and shall be unique and not duplicated on other patch cords. Permanently apply the identification numbers on the cable jacket or connectors.

B. Twisted Pairs, Copper Wire Portable Patch Cords

1. Twisted Pairs portable patch cords, general:
 - a. "Male" eight-position modular "RJ" male style jacks install on each end of the patch cord cable. The jack shall be provided with a rear "fin" to prevent the plug tab from snagging when pulled backwards through adjacent wiring.
RJ-45 style "male" jack, typical unless noted otherwise.
 - b. Patch cord cable shall be UTP and ANSI/EIA-Category rating, shall match respective premise wiring, 4-pair twisted, stranded copper individually insulated wires, thermosplastic jacket over all the wires and shield.
 - c. Connectors shall comply with FCC 68.5 and Part 68 Subpart F.
 - d. Connectors UL listed and shall comply with UL-94V-O.
 - e. Contacts gold plated with not less than a 750 insertion/withdraw cycle rating.
2. Portable patch cord quantities and lengths for connecting port-to-port equipment rack patch panels
 - a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire equipment workstation outlet patch port in the equipment rack patch panels. One-to-one straight through pin-to-pin wiring. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for copper wire computer workstation outlets in the equipment rack patch panels. Cable jacket color shall be blue:
 - b. Provide the following lengths of copper wire patch cables for copper wire equipment rack patch panel outlets.
 - 1) 2-feet long - 10% of total quantity
 - 2) 4-feet long - 30% of total quantity
 - 3) 6-feet long - 30% of total quantity
 - 4) 10-feet long - 20% of total quantity
 - 5) 16-feet long - 10% of total quantity
3. Portable patch cord quantities and lengths - for connection from equipment workstations to equipment workstation outlets, located remote from equipment racks.
 - a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire work-station outlet located remote from the equipment rack patch panels. Provide additional spare patch cords, quantity equal to 15% of the total quantity of patch cords provided for each copper-wire computer workstation outlets. Cable jacket color shall be blue:
 - 1) Infrastructure network outlet segments the pin-to-pin patch cord wiring configuration and jacks shall be compatible with the equipment protocol communications interface, and the respective workstation outlet.
 - b. Provide the following lengths of copper wire patch cables for equipment copper wire infrastructure network workstation outlets. The patch cords shall provide internal cross-over wiring to conform the pin-to-pin connections required between the equipment workstation outlet and the equipment protocol communications interface installed in the respective work-station equipment:
 - 1) 8-feet long - 30% of total quantity
 - 2) 15-feet long - 70% of total quantity

4. Portable patch cord quantities and lengths for connection from electronic equipment rack patch panel ports to equipment installed in equipment racks, such as HUB's, servers, switches, router, telephone and concentrator equipment ports. Cable jacket color shall be white.
 - a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire outlet port located in electronic equipment. Provide additional spare patch cords, quantity equal to 25% of the total quantity of the equipment rack equipment ports.
 - 1) The pin-to-pin patch cord wiring configuration and jacks shall be compatible with the respective equipment and patch panel outlets as applicable.
 - b. Provide the following lengths of copper wire patch cables for outlet ports located in electronic equipment installed in equipment racks. The patch cords shall provide quantity of conductors, wiring shall conform the pin-to-pin connectors and jack/ connectors to the ports in the equipment mounted in the equipment racks.
 - 1) 4-feet long - 15% of total quantity
 - 2) 6-feet long - 30% of total quantity
 - 3) 10-feet long - 35% of total quantity
 - 4) 16-feet long - 20% of total quantity
 5. Portable patch cord quantities and lengths for connection of equipment requiring customized pin-to-pin wiring configurations and/or customized port connector configurations. Cable jacket color shall be tan.
 - a. Patch cord quantity: Provide one complete patch cord assembly for each outlet port install as part of the Contract and not identified in any other patch cord descriptions. The patch cords shall be customized and configured to comply with the respective Manufacturers recommendations.
 - b. Provide one patch cord for each port-to-port connection length as required for actual installation condition.
 - 1) Provide 100% spare but not less than one spare patch cord for each custom configuration.
- C. Telephone/Voice Copper Wire Portable Patch Cords-110 style
1. 110 style jacks for plugging into the 110 style connecting blocks located in the telephone/ voice terminal blocks.
 2. Patch cords shall be UTP 4-pair twisted, 24AWG stranded copper individually insulated wires with a thermoplastic jacket over all the wires. Cable shall be ANSI/TIA/EIA-568C.
 3. Patch cord quantity and length - telephone/voice terminal block:
 - a. Provide one complete patch cord assembly for each copper wire telephone/voice outlet connecting to the telephone/voice terminal block. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for telephone/voice 110 patch cords.
 - b. Provide the following lengths of copper wire patch cables for telephone/ voice 110 style connecting block portable patch cords.
 - 1) 3-feet long - 25% of total
 - 2) 5-feet long - 50% of total
 - 3) 15-feet long - 25% of total

D. Coaxial Cable Portable Patch Cords

1. BNC type connectors on each end of each patch cord. Shall be compatible with patch panel outlets, workstation outlets and respective equipment rack electronic equipment.
2. Patch cord quantity: Provide two complete patch cord assemblies for each coaxial cable outlet.
 - a. One patch cord for workstation outlet located remote from the equipment rack patch panel, 15-feet long each patch cord.
 - b. One patch cord for equipment rack (IDF/MDF) patch panel each outlet location, 10-feet long each patch cord.
 - c. Provide 15% additional spare patch cords of each patch cord length.

E. Fiber Optic Portable Patch Cords

1. General
 - a. Provide fiber optic fiber connectors installed on each fiber end of the patch cord cable. The fiber optic portable patch cord shall be "single" with one fiber strand type, for each patch cable. The connector shall be mechanically and optical compatible with the respective connecting patch panel couplers and network work equipment couplers.
 - b. The entire patch cord assembly total insertion loss shall be less than 1.0dB at the specified operating wavelengths.
 - c. Operating temperature range 30-degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
 - d. Each fiber shall be individually identified with factory color-coding and factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with Agency listing identification. The cable jacket color shall be yellow.
 - e. All fiber optic patch cord cable shall be a product of the same Manufacturer.
 - f. Optical fiber shall be coated, 900 micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
 - g. A dielectric strength member shall surround the fiber assemblies.
 - h. An outer dielectric jacket shall envelope the entire cable.
 - i. The cable shall be UL listed and comply with NEC and NFPA Requirements for each installation location shown in the Contract Documents.
 - j. Patch cord quantity and length
 - 1) Patch cord quantity: Provide one complete patch cord assembly for each fiber optic patch panel outlet in the equipment rack.
 - 2) Provide one complete patch cord assembly for each computer workstation fiber optic outlet remote from the patch panel.
 - 3) Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided.
 - k. Provide the following quantities and lengths of fiber optic patch cords.
 - 1) 3-feet long - 20% of total
 - 2) 6-feet long - 35% of total
 - 3) 10-feet long - 30% of total

- 4) 20-feet long - 15% of total
2. Multimode patch cords
 - a. Patch cord cable shall be fiber optic cable with equal or better characteristics as the premise fiber optic cables.

2.17 CIRCUIT PROTECTORS

- A. General
 1. The circuit protectors shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
- B. Circuit Protectors
 1. Cables containing non-dielectric electrical conducting components entering from the exterior of the building shall be provided with individual circuit protectors combining both lightning circuit protection and SPD circuit protection on each circuit conducting component, as required in CEC Articles 770 and 800.
 2. Install circuit protectors in the respective backboard/equipment rack where copper wire conductors terminate, connect each protector to room/closet ground bus equipment with #10AWG green insulated bond/ground copper conductors.

PART 3 - EXECUTION

3.01 NETWORK CABLE TESTING AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

- A. General
 1. In addition to the testing recommended in ANSI/TIA/ EIA-568C and related Standards, Amendments and TSB. End-to-End test 100% of all individual optical fiber, individual copper wire conductors, each outlet and each connector in all terminated and unterminated cables, portable patch cord, outlets and patch panels provided in the Contract, shall be tested after installation as a complete channel pathway installation, splicing outlets and termination is completed, including the following end-to-end tests on each installed individual circuit;
 - a. Each circuit wire and fiber map and length
 - b. Each circuit insertion Loss
 - c. Each circuit NEXT (Pair-to-Pair) Loss
 - d. Each circuit NEXT Loss (Power Sum) PS
 - e. Each circuit ELFEXT Loss (Pair-to-Pair)
 - f. Each circuit ELFEXT Loss (Power Sum) PS
 - g. Each circuit return Loss (RL)
 - h. Each circuit propagation delay
 - i. Each circuit propagation delay-skew
 2. The test equipment and (Tester) shall comply with the Accuracy Requirements for Field Testers as defined in the ANSI/EIA/TIA Standards for the specific cable type. The Tester including the appropriate interface adapter shall meet the Specified Accuracy Requirements. The Tester shall be within the calibration period recommended by the

Vendor in order to achieve the Vendor-specified measurement accuracy. The Tester shall be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Contractor shall provide proof that the interface has been calibrated within the period recommended by the Vendor.

3. The Pass or Fail condition for the channel pathway link-under-test is determined by the results of the required individual tests (ANSI/EIA/TIA) Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass. A Pass or Fail result for each parameter is determined by comparing the measured values with the ANSI/EIA/ TIA test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field test. The Field Test Equipment Manufacturer shall provide documentation as an aid to interpret results marked with asterisks.
4. Provide all test equipment, Certified Testing Personnel, and setups. Shall comply with ANSI/EIA/TIA and Equipment Manufacturer's recommendations and standards of practice.
5. Provide six copies of all test reports, bound in three ring binders. Provide three digital CD/DVD ROM copies. Organize test reports into rows-and-columns spread-sheet format, with data common groupings by IDF and NDF location. Submit to Owner's Representative.
6. The Contractor shall repair or replace equipment, cables, outlets, connectors, splices, terminations, etc. identified during testing as not complying with the Contract Documents, without additional cost to the Contract. Retest all replaced or repaired components at Contractor's expense.

B. Twisted Pair Copper Wire Testing

1. Channel insertion loss (dB).
2. Channel near-end cross-talk NEXT loss (dB).
3. Channel equal-level far-end cross-talk ELFEXT (dB).
4. Channel return loss (dB).
5. Channel power sum PSACR (dB).
6. Channel propagation delay, propagation speed, and delay skew.
7. Channel wire map and circuit length.
8. Channel ring-out test for continuity and correct point-to-point matching terminals.
9. Channel DC resistance and capacitance.
10. Channel attenuation-to-cross-talk ratio ACR.

C. Coaxial Cable Testing

1. Channel full specified frequency spectrum attenuation insertion loss (dB).
2. Channel wire mapping, ring-out and circuit length.
3. Channel propagation delay and propagation speed.
4. Channel impedance and continuity for center conductor and shields.

- D. Fiber Optic Cable Testing, Optical Testing for Each Specified Wave-Lengths for Both laser and LED sources.
 - 1. Channel link insertion losses (dB) OLTS.
 - 2. Channel loop-back attenuation (dB).
 - 3. Channel signature Optical Time Domain Reflectometer – OTDR, for installation characterization testing (event and attenuation resolution dead zone at specified wave lengths, shall be less than 10-feet).
 - 4. Channel continuity and correct point-to-point matching terminals.
 - 5. Channel propagation delay and propagation speed.
 - 6. Channel fiber optic mapping, circuit length, and tracing.

3.02 FIBER OPTIC CABLE TYPE

- A. General
 - 1. Cables shown as fiber optic type shall comply with the following installation locations.
 - 2. Provide matching compatible outlets and terminate all fiber optic cables into matching fiber optic connectors.
 - 3. Fiber optic cable installed in indoor locations without enclosed raceway or conduit.
 - a. Provide non-metallic, flexible corrugated continuous inner duct-raceway and install fiber optic cable in the innerduct.
 - b. Innerduct shall be heavy duty, plenum-rated, Limited-Combustible (LC) type UL FHC – 25/50, orange color. Support innerduct 36-inches on center, independent of ceiling supports and independent of other equipment supports.
 - c. Innerduct size shall be selected to insure percentage-fill with fiber optic cables shall not exceed 30%, but in no case less than 1.25-inch diameter innerduct.
- B. Provide loose tube gel filled or indoor/outdoor type fiber optic cable for any of the following installation location conditions.
 - 1. Inter building (between buildings)
 - 2. In a conduit or raceway located underground below grade.
 - 3. In an exposed outdoor conduit or raceway not located underground or below grade.
 - 4. Do not install loose tube gel filled type fiber optic cable inside a building or exposed on a building without providing Rigid Steel (RGS) conduit raceway for the loose tube gel filled fiber optic cable along the entire length of the cable inside the building or on the building.
- C. Provide tight buffered or indoor/outdoor type fiber optic cable for any of the following installation location conditions.
 - 1. Intra-building (inside a building) where raceway continuously encloses the cable and the raceway is not located underground, below grade.
 - 2. In an exposed outdoor conduit or raceway not located underground or below grade.

- D. Provide plenum rated type fiber optic cable for any of the following installation location conditions in building spaces.
1. Any building space air plenum (supply or return) when a conduit or enclosing raceway is not provided for the entire cable length. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
 2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in a building. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
 3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
 - a. Limited-Combustible (LC) UL FHC-25/50 plenum rated cable.
 - b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.
- E. Optical Fiber Quantity:
1. The minimum fiber quantities in each fiber optic cable shall be as follows, but in no case less than indicated on the Drawings.
 2. Between main IDF (SUB-MDF) in separate buildings and the MDF main terminal rack fiber optic patch bay for the entire site/campus.
 - a. Twenty-four optical fibers, multimode plus six optical fibers, single mode.
 3. Between satellite IDF terminal rack fiber optic patch bays and the main terminal rack IDF (sub-MDF) patch bay located in the same building.
 - a. Twenty-Four optical fibers, multimode plus six optical fibers, single mode.
 4. Between a terminal rack patch bays (IDF or MDF):
 - a. To an individual workstation outlet located inside the same building - two multimode optical fibers, (typical only for locations where fiber is specifically shown on the Drawings for the specific work station outlet).
 - b. To each network file server outlet location whether or not shown on the Drawings, four optical fiber, and multimode.
 5. Between a terminal rack-patch bay and individual multimedia network (television/video/audio) workstation outlets and/or intrusion/access program display devices located inside the same building - two optical fibers, multimode.
 6. Other locations as indicated on the Drawings or described in the Contract Documents.

3.03 COPPER WIRE CABLE TYPE

- A. General
1. Cables shown as copper wire type shall comply with the following installation conditions, unless noted otherwise on the Drawings.
 2. Provide matching compatible outlets and terminate all copper wire cables into matching copper wire connectors.

- B. Cable Types and Quantities - Cable types and quantities shall be as follows unless specifically noted other-wise on the Drawings. The following minimum type and quantity of copper wire cables from each individual workstation/device outlet, to the respective terminal equipment patch panel/bay, (unless specifically noted otherwise), but in no case less than what is shown on the Drawings and in no case less than one 4-pair cable to each outlet "Jack" position:
1. Two Category-6A, UTP 4-pair cable:
 - a. Each network workstation outlet location.
 - b. Each network "wireless-access-point" outlet location.
 2. One Category-6A UTP 4-pair cable, for each telephone handset (instrument) workstation outlet location.
 3. Trunking-Cables shall be Category-5E.
 - a. 100-pair between buildings main IDF (SUB-MDF) and campus main MDF.
 - b. 50-pair inside building between SUB-IDF to buildings main IDF (SUB-MDF).
 4. Other locations as indicated on the Drawings or described in Contract Documents.
- C. Provide plenum rated copper wire cable for any of the following installation location conditions in building spaces.
1. Any air plenum (supply or return) when a conduit or enclosed raceway is not provided for the entire cable length. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
 2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in the building. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
 3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
 - a. Limited-Combustible (LC) UL FHC-25/50 plenum rated cable.
 - b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.
- D. OSP Insulated Copper Wire Cables
1. Outside – Plant (OSP) CEC/NEC rated, UL listed, labeled and approved insulated copper wire cable assemblies. Moisture barrier resistant and UV resistant cable jacket. Non-flammable, water blocking, non-conductive gel internally filled infrastructure cable assembly.
 2. Provide rated insulated copper wire OSP type cable for any of the following copper wire infrastructure cable install locations.
 - a. In underground conduit or in conduit under the building.
 - b. In conduit exterior to the building, or in conduit exposed outdoor on the building.
 - c. Outdoor aerial with aerial messenger wire cable carrier.
 3. Except for aerial install locations, install all OSP cable in continuous conduit pathways, end-to-end.

3.04 CABLE INSTALLATION

A. General

1. Cables connecting to equipment racks and terminal blocks shall be installed with not less than 6-feet of slack cable between the equipment rack/terminal block and terminal backboard. The slack cable shall be coiled and supported on the backboard and/or cable tray.
2. Cables in terminal closets and terminal rooms shall be trained, dressed and racked on the plywood backboards. Provide cable, metal support arms and re-enterable type cable support rings not less than 12-inches on center mounted onto the plywood along the entire length of all cables.
3. Provide separate routing paths on plywood backboards for fiber optic cables, computer data and copper wire cables and telephone/voice copper wire cables and multimedia, audio/video, TV cables. Provide separate routing paths on plywood backboards for shielded copper wire cables and unshielded copper wire cables.
4. Cables shall be routed parallel to floors and walls. Do not route cables diagonally on backboards.
5. Spare cable slack
 - a. Provide 25-feet of cable slack where unterminated cables are specified at terminal backboards.
 - b. Provide a minimum of 18-inches of slack cable in each workstation outlet box and outlet locations.
 - c. Provide 10-feet of cable slack in ceiling above each work station outlet.
 - d. Provide 24-inches of slack in each cable at patch panel locations.
 - e. Coil and "Velcro" wrap slack cable.
6. Provide "horizontal wiring" cables installed from individual equipment locations and workstation out-lets to respective MDF/IDF terminal closet/room patch panel. Cables shall be continuous without cutting or splices.
7. Provide "backbone" cables installed from each IDF location to respective MDF/ Sub-MDF location terminal closet/room patch panels. Cables shall be continuous without cutting or splices.

B. Cable Pulling Lubrication

1. Cable pulling lubricants shall be specifically approved by the Cable Manufacturer. The following lubricants shall be used where approved by the Cable Manufacturer.
 - a. Slip X -300, American Colloid Co.
 - b. Bishop #45, Bishop Electric.
 - c. MacLube CA51, MacProducts.
 - d. Minerallac H2B,- Minerallac Electric.
 - e. Winter grade #7437-PC, General Machine Products.
 - f. Gel-lube 7/5, Cable associates.
 - g. Polywater, A, C, G - American Polywater.
2. Lubricants shall be continuously applied as cable enters raceway.

C. Cable Installation:

1. Do not pull conductors until factory test reports have been submitted and reviewed.

2. Minimum bending radius of fiber optic cables shall not be less than the following. Maximum pulling tension shall not exceed the following. In no case shall the Manufacturer's recommendations be violated.

<u>Cable Type</u>	<u>Cable Fiber Quantity</u>	<u>Minimum Bend Radius</u>	<u>Maximum Pulling Tension</u>
Loose Tube	2-84	9 inches	600 pounds
Loose Tube	86-192	10 inches	600 pounds
Tight Buffered	2-12	5 inches	400 pounds
Tight Buffered	14-24	7 inches	600 pounds
Tight Buffered	26-28	11 inches	1100 pounds
Tight Buffered	48-72	12 inches	1200 pounds

3. The minimum bending radius for copper wire cables shall be 10 times the cable outside diameter. The maximum pulling tension and minimum bending radius shall not violate Manufacturer's recommendations.
4. Cables installed in manholes and pullboxes on terminal backboards shall be installed on wall mounted cable support racks.
5. Provide a full 360-degree loop of cable around manhole and pullbox interiors.
6. The attachment of pulling devices directly to the cables shall be with individual split mesh basket grips. Direct connection for pulling cables to cable fibers and copper wires shall not occur. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.
7. The attachment of the pulling device to the cable basket grips shall be made through a swivel connector.
8. The Contractor shall ensure that the cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".
9. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway.
10. Cables shall be "pulled through" or pulled from a "center of run pull" without splices or terminations and minimize cable rolling tension. Lead-out the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next portion of the cable run.
11. For each cable pull where a cable direction change is required, flexible feed-in tubes, pullout devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Cables shall not be pulled directly around a short right angle bend. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable side-wall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.
12. Cable lengths over 50 feet shall be machine pulled not hand pulled into and through all raceways. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than

50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.

13. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pull-hole during this operation. Cables shall be pulled directly from cable reels.
14. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts, conduits or cables. To prevent damage from falling objects or personnel entering the manhole the cables shall not pass directly under the manhole opening.
15. Cable shall be supported in manholes, pull boxes and vaults a minimum of 18-inch on center with cable racks. Provide hot dip galvanized, T-slot racks and support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more than one feeder on the same rack hook.
16. Cables shall be routed the long way around manhole, pull-hole, etc. with not less than a full 360-degree loop around the perimeter walls unless noted otherwise.
17. Existing conductors shall be protected at all times when Contract work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.
18. Where cable tray is provided, all cables shall be routed and trained on the cable tray. The cables shall enter the cable tray and route along the tray prior to entering any equipment racks or computer works station outlets.
19. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200-feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.
20. Bends shall not be made in cable splices or terminations.
21. The portions of cables installed without raceways or cable tray supports shall be installed with metal "J-hook" cable supports.
 - a. The "J-hooks" shall provide multi-tiered "J" shaped hooks, with wide flat cable support base (0.5 inch wide minimum) and smooth rounded corners. Specifically designed for copper wire and fiber optic infrastructure cable support as manufactured by Erico Inc.
 - b. The individual "J-hook" attachment to the building structure shall be metal, "beam clamp", "hanger rod", clevis hanger styles as applicable for each attachment location.

- c. Install “J-hooks” not more than 48-inches on center along the entire cable length and within 6 inches of each cable change in direction. Locations of “J-Hooks” and tension of cables shall insure between 4-inches and 6-inches of cable sag between adjacent hooks. Secure cables to “J-hooks” with re-enterable cable tie wraps. “J-hook” supported cables, bundle cables together with re-enterable tie wraps not less than 12 inches on center along the entire cable length.
 - d. Each J-hook shall not support more than 12 individual cables. Provide multiple “tiered” J-hooks for additional cable quantities at each location.
 - e. “Bridle rings” shall NOT be used to support cables.
 - f. Cables shall not lie directly on nor attach to ceilings, ceiling hangers, lighting fixtures, air ducts, piping, or equipment.
22. Re-enterable cable tie wraps shall be, “limited-combustible” and air plenum rated, reusable, color coded. Chemically and mechanically compatible with the respective cables and install locations. Shall allow multiple open-close operations for securing cables.

23. Electronic network cables containing non-dielectric components shall be installed with a minimum separation from other electrical power conductors and equipment as follows:

<u>Equipment Type</u>	<u>Minimum Separation</u>
a. Lighting fixtures	12 inches
b. Electric motors, electric solenoids, electric Heaters	40 inches
c. Transformers	48 inches
d. Circuits over 100 volts to ground, in metallic raceways	5 inches
e. Circuits over 100 volts to ground, in non-metallic raceway or without any raceway	12 inches
f. Circuits over 100 volts to ground, suspended on overhead pole lines	48 inches

D. Movement, Storage, and Handling of Cable:

- 1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.
- 2. Lift and move cable reels using following methods:
 - a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
 - b. Forklift type of equipment may be used to move smaller, narrower width reels. Fork tines should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
 - c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear of debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.
- 3. Storage of reels of cable:
 - a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2-inches down

to insulation. Then apply four layers of an insulating tape criss-cross over the cable end and carry back at least 4-inches onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.

- b. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
- c. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
- d. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

3.05 CABLE SPLICES

A. General

1. Splice(s) in cables shall occur only in the following locations:
 - a. Pullboxes or manholes.
 - b. Terminal backboard, closets or rooms.
 - c. Equipment racks.
 - d. Wall mounted interface cabinet.
 - e. Do not splice cables in conduit, cable tray, raceways or plenums.
2. Polarity and color-coding shall be maintained consistent through splices, terminations and outlets for the entire electronic network system.
3. Cable splices in outdoor areas, manholes, pullholes shall be water tight, inside universal splice enclosures.

B. Fiber optic cable splices unless specifically indicated otherwise below, fiber optic cable splices between fiber optic cables fibers shall be fusion type splices.

1. Splices between loose tube gel filled fiber optic cable fibers shall be fusion type splices.
2. Splices between indoor/outdoor fiber optic cable fibers shall be fusion type.
3. "Pigtail" splices of tight buffered and indoor/outdoor fiber optic cable fibers to loose tube gel filled cables shall be fusion type splice.
4. Splices between tight buffered fiber optic cable fibers to indoor/outdoor fiber optic cables shall be fusion type splice or mechanical type splice.
5. Splices between tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
6. "Pigtail" splices of tight buffered fiber optic cable fibers to tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
7. Fiber optic splices shall be performed to maintain the data transmission rates specified for the entire respective system.

C. Copper Wire Splice

1. Copper wire extending from infrastructure workstation outlets to respective equipment rack patch panel outlets shall not be cut or broken and shall be continuous end to end.
2. Copper wire extending from telephone/voice workstation outlets to respective terminal blocks shall not be cut or broken and shall be continuous end to end.

3. Continuity of cable shields (where occurs), polarity and color coding shall be maintained across all splices.
4. Copper wire splices shall be performed to maintain the data transmission rates specified for the entire respective system.

3.06 CABLE TERMINATIONS

A. General

1. Infrastructure workstation outlets connecting to ports in patch panels and terminal blocks shall be grouped together in the patch panel and terminal block by outlet function, room location and building area location (i.e. Group #1 Room #120 1st floor; Group #2 Room #200 east wing, etc.). Each group shall be identified with engraved (etched) nameplates indicating grouping identification and individual port numbers.
2. Polarity and color coding of cable connections at splices, terminations and outlets shall be consistently maintained throughout the entire electronic network system.
3. Terminate all cables onto respective outlets connectors, interconnection couplers and terminals. Terminations shall comply with Manufacturer's recommendations; ANSI/TIA/EIA-568C related Standards, Amendments and TSB.
4. Fiber optic cable fiber strands and copper wire cable conductors terminated at outlet locations shall be connected with a strain relief device attached to the cable jacket to prevent cable tension from being transmitted to the termination connectors.
5. Cable terminations shall be performed to maintain the data transmission rates specified for respective entire system.

B. Fiber Optic Terminations

1. Individual fiber optic fibers shall each be terminated with a fiber optic fiber connector. The connector for each fiber shall be "plugged" into separate fiber optic fiber interconnection couplers on the rear of each respective outlet.
2. Each fiber optic termination ferrule shall be inspected, after completion of the termination, visually with a fiber optic inspection microscope and an interferometer, to insure fiber "undercut", "protruding" fiber, over polish and under polish of fiber termination ends does not exist in the finished termination ferrule.
3. Fiber optic cables terminated between two fiber optic patch panels located in separate equipment racks. The fibers shall be paired together (Duplex-Pair) for purposes of identification and connection transmit/receive pair. Each pair of connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber duplex-pair interconnection couplers at each patch panel. The horizontal/ vertical arrangement of paired patch panel fiber couplers shall match at both ends of the fiber cable.
4. Fiber optic cable fiber strands terminated at patch panels shall be installed with a minimum of 540 degrees of each fiber strand looped around the splice tray individual fiber "training" rings.
5. Fiber optic cable connecting from infrastructure workstation outlet to a fiber optic patch panel.
 - a. The connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber interconnection couplers.

- b. The patch panel coupler shall be color coded to identify the polarity of the transmitting and receiving optical fibers.
 6. Fiber optic cable connections at workstation outlets.
 - a. The connectors for fibers shall be "plugged" into separate physically adjacent fiber optic fiber interconnection couplers in the outlet.
- C. Copper Wire Terminations
1. Where occurs, the shield on metal shielded copper wire shall be terminated and connected to the shield grounding connection at each termination point.
 2. Twisted wire pairs shall not be untwisted for a length of more than 0.4-inch at any location and the cable jacket shall not be striped back not more than 0.5 inch any location including splices and terminations.
 3. Unless specifically directed otherwise by the Owner's Representative, Pin assignment for wiring terminations shall comply with ANSI/TIA/EIA-568C type T568A or Type T568B as required for compatibility with the electronic network equipment. The termination type shall be consistent throughout the Project Contract area.
 4. Copper wire termination's shall be performed to maintain the transmission rates specified for the respective entire system.

3.07 EQUIPMENT RACKS

A. General

1. Install, assemble, mount and connect devices and equipment in the respective equipment racks, bolted securely to the rack frame with stainless steel hardware. "Star" style lock washers shall be provided to insure an electrically continuous ground path between the equipment/devices and rack frames.
2. Provide blank metal filler panels to close unused equipment "front" mounting space in equipment racks, Manufacturer's standard finish color.
3. Provide a copper wire outlet connector in the respective equipment rack for each remote copper wire infrastructure workstation outlet and copper wire cable shown connected to the respective equipment rack, plus the spare copper wire outlet connectors required in the Contract Documents. The copper wire outlet connectors in the equipment racks shall be provided in equipment rack mounted copper wire patch panels. In no case shall the quantity of equipment rack mounted copper wire outlet connectors be less than the quantity of cables indicated on the Drawings, plus required spaces/spares.
4. Provide fiber optic fiber connectors and fiber optic fiber interconnection couplers in the respective equipment rack for each remote fiber optic infrastructure workstation outlet, and fiber optics cable fiber shown connected to the respective equipment rack, plus the spare fiber optic fiber connectors required in the Contract Documents. The fiber optic fiber connectors and fiber optic fiber interconnection couplers in the equipment racks shall be provided in equipment rack mounted fiber optic fiber distribution enclosures (RTDE). In no case shall the quantity of equipment rack mounted fiber optic fiber connectors and fiber optic fiber interconnection couplers be less than the quantity of cables indicated on the Drawings, plus required spaces /spares.

5. Fiber optics cable fibers specifically shown as non-terminated "splicing-thru" in the equipment rack shall route through fiber optic splice only enclosures (RMSE), mounted in the respective equipment rack.
6. The maximum quantity of cable terminations, in each equipment rack mounted patch panels shall not exceed the following. To insure not less than 50% of the rack space remains available for equipment installation:
 - a. 100% copper wire outlet connectors, 196 maximum per rack.
 - b. 100% fiber optic fiber terminations, 144 maximum per rack.
 - c. Combination of copper wire outlet connectors and fiber optic fiber terminations in the same rack; 48 maximum fiber optic fibers plus 144 maximum copper wire outlet connectors per rack. 18 maximum fibers plus 48 maximum copper wire in 30 inches high.
 - d. In addition to the quantity of patch panel outlets for termination of incoming and outgoing cables, provide not less than an additional 15% of patch panel spare outlets of each type, in each equipment rack for future use.
7. Provide additional equipment racks, quantity of racks to ensure the maximum specified quantity of terminations in single rack are not exceeded and the quantity of cable terminations complies with the Requirements of the Contract Documents.
8. Terminal racks, equipment locations, patch panels, and cross connects shall be arranged to allow for natural cabling progression, minimize crossing of cables and allow easy access to each system component.
9. Equipment Rack Anchorage:
 - a. Equipment racks installed on raised "access floor" systems, shall be supported and anchored with bolts that extend into the "structural" floor located below the "access floor".
 - b. Securely anchor the support arms of swing gate racks to the wall structural support system.
 - c. Securely anchor fixed support base of the racks to the floor.
 - d. Mounting method shall support the total rack weight including installed equipment, but in no case less than 500 pounds with a 2.0 times safety factor.
 - e. Attachments and anchorages shall comply with the Requirements for earthquake seismic rating at the install location.
10. Unless specifically noted, otherwise provide the following equipment rack types:
 - a. Floor standing equipment racks containing patch panel locations, computer/data network HUBS/switches and computer data network concentrators, shall be Swing Gate style equipment racks.
 - b. Floor standing equipment racks containing multimedia, audio/video, TV head end equipment, shall be Metal Enclosed equipment racks.
 - c. Wall mounted external to dedicated IDF/MDF terminal rooms/closets (i.e. inside individual classrooms), shall be Mini-Equipment racks.
11. Install ground bus, PDU/SPD, cable management rings, equipment, patch panel and patch panel out-lets, etc. in equipment racks.

12. Equipment rack terminology:
 - a. The location containing the main campus equipment rack location shall be identified as the Main Distribution Frame – (MDF).
 - b. The locations remote from the MDF containing satellite equipment racks shall be identified as Intermediate Distribution Frames (IDF).
 - c. A individual building located on a multi-building campus site with multiple equipment rack locations in the building, the building main rack location shall be identified as Sub-MDF (or building MDF) and the remaining equipment rack locations in the building shall be identified as IDF.
- B. Swing Gate Racks
 1. Position the swing gate rack frame to provide a minimum of 30-inches clear space behind the moveable swing gate, for deep recess rack mounted equipment enclosure clearance. 42-inches in front of each rack to allow space for swing-gate 90-degree open position and still allow personnel passage way with the swing gate open. Not closer than 30-inches from rack frame to side-adjacent walls, to allow rack to swing full open with installed equipment.
 2. All incoming cables shall enter from the back of the rack. The cables shall cross the hinge side of the rack with sufficient cable slack to allow opening and closing of the swing gate.
 3. Provide unobstructed open-close operation clearances of the moveable swing gate. Do not install the edge of the rack closer than 30 inches to an intersecting perpendicular surface or wall.
 4. The bottom of the moveable swing gate frame shall be approximately 6-inches above the finish floor.
 5. Multiple swing gate equipment racks installed adjacent to each other along a common backboard/wall shall be spaced not less than 44-inches center line to center line and to insure the rack-gate can swing open a full 90-degree Arc with 24-inches deep rack mount equipment enclosures. Adjacent equipment rack with side-by-side hinges on the same side of the rack (left-right) may reduce the edge-to-edge rack side by side spacing to 6-inches for the respective combined two rack location.
 6. The fixed non-moving bottom of the rack shall be securely anchored to floor.
- C. Floor Standing Equipment Racks
 1. General:
 - a. Securely anchor racks to floor.
 - b. All incoming cables shall enter through the top or bottom of the racks.
 - c. The front of the racks shall maintain a minimum of 42-inches of clear working space.
 - d. Multiple floor standing racks shall be installed directly adjacent to each other (i.e. side by side), with not less than 6-inches (edge-to-edge) space between adjacent racks.
 - e. Cables entering racks shall enter into the top of the rack from overhead cable tray, or from wall along wall support arms to rack.
 2. Floor standing metal enclosed equipment racks:
 - a. The rear of the rack shall maintain a minimum of 36 inches clear working space.

- b. Provide a minimum spacing between adjacent (edge-to-edge) racks of not less than 6-inches.
- 3. Floor standing open (non-swing gate) equipment racks.
 - a. The rear of the rack shall maintain a minimum of 54-inches clear working space behind the rack frame rails for adequate installation depth of HUBS/switches equipment, for "walk" behind access to equipment and for cable terminations access.
 - b. Provide a minimum spacing between (edge-to-edge) racks of not less than 6-inches.
- 4. Floor standing modular frame equipment racks:
 - a. The rear of the racks shall abut against the wall, or as shown on the Drawing.

3.08 TELEPHONE/VOICE TERMINAL BLOCKS

- A. The telephone/voice terminal blocks shall be assembled in vertical sections, for wall mounting. Install adjacent vertical sections with not less than 8-inch blank space between sections, for cable training space.
- B. Install terminal blocks on plywood terminal backboard with #8 x 1-inch wood screws. Minimum 6-inches on center, along each side of each terminal block.
- C. Terminal block wire pair capacity:
 - 1. The minimum wire termination capacity shall not be less than 600 pairs of telephone/voice conductors, at any telephone/voice terminal block.
 - 2. The quantity of wire pair terminations provided at each terminal block shall be based on the following formula. However, under no case shall any terminal block wire pair capacity be less than the specified minimum.

Total quantity of telephone/voice feeder copper wire pairs connected to the terminal board = QFP

Total quantity of telephone/voice outlets connected to terminal board - QTO

(QFP) x (QTO x 4) + (specified spares) = Minimum terminal block pair capacity.

3.09 MDF AND IDF CIRCUIT TERMINAL ROOMS AND CLOSETS

- A. Terminal Backboard
 - 1. A ¾-inch thick marine "A-C" grade plywood backboard shall fully cover each wall of terminal closets and terminal rooms, including all MDF and IDF rooms/closets. Provide backboard on the wall for equipment racks, incoming cable raceways and terminal blocks. Plywood shall extend continuous from the finish floor to 8-feet above the finish floor on all walls. "A" side of plywood shall be exposed.
 - 2. Attach plywood to wall structural framing with mechanical fasteners a minimum 6-inches on center vertically on walls at each framing vertical member, and along the length of the wall, but not less than 16 inches on center horizontally along the length of the wall.
 - 3. Paint plywood terminal backboards after installation and prior to mounting any equipment. One coat of wood paint fire resistant primer and two coats of fire resistant/intumescent, non-conductive finish coats of paint. Finish color matt/ flat white, acrylic enamel fire resistant/retardant latex paint.

B. Cable Tray

1. Locations with equipment racks, and/or terminal blocks are installed in the same room/closet (MDF or IDF).
 - a. Provide a horizontal cable tray above the equipment racks and terminal blocks in each circuit terminal room and closet.
 - b. Provide a horizontal cable tray continuous "loop" around the perimeter inside each MDF and IDF room, within 12-inches of the ceiling. Parallel with and adjacent to all walls in the room.
2. Ladder type cable tray 18 inches wide by 6 inches deep; length-end wall to end wall, of the closet or room.
3. Install the cable tray centered above all equipment racks, and around the room perimeter at ceiling/ walls and terminal blocks with ceiling and wall suspension system. Install trays not more than 36-inches above and not less than 12-inches above the top of the equipment racks.
4. Where multiple segments of cable trays occur in terminal closets and rooms, provide interconnecting cable trays between each segment located in the respective room/closet.

C. Conductor Training and Support

1. Provide conductor/cable training and racking support distribution rings installed on backboards. As manufactured by Newton 3042 series, Saunders or equal.
2. Support rings shall be spaced a minimum of 10-inches on center along all cable/conductor routing paths on backboards and within 4-inches of each change in cable/conductor direction.
3. The capacity of support rings shall be equal to the weight and quantity of conductors/cables passing through the respective support ring plus 100% spare capacity for installation future conductors/cables. In no case shall support rings be smaller than 3 inches.
4. Attach support rings to backboards with not less than two 3/8-inch diameter by 1½-inch long threaded wood anchor bolts for each individual bracket.

D. Environment Space Monitoring (MDF and IDF)

1. In each room/closet provide one automatic environmental monitor. Self-calibrating, simultaneous monitoring and software programmable, with alarm set points. Shall measure and monitor ambient conditions and provide data-logging for conditions in the space for the following:
 - a. One ambient temperature port and plug-in indoor sensor.
 - b. One ambient humidity port and plug-in indoor sensor.
 - c. One spare plug-in port for an external digital sensor.
2. Digital Fast Ethernet LAN RJ-45 communications port, with alarm alerting and communications software for remote monitoring of the ambient conditions via the LAN. Multi-user site wide software license, compatible with PC-computer and IP-WEB HTTP remote operations.
3. Local internal audio and visual alert annunciators, with local silence and reset.

4. 120 volt, 60Hz AC input power supply operation. Equipment rack mount self-contained unit housing configuration. Provide all interconnect cabling and connectors.
5. Provide the environmental unit in one of the equipment racks located in each of the respective spaces.
6. As manufactured by Avtech-Room Alert; or SensaTronic-Environmental Systems; or IT Watch Dog-Climate Monitors.

3.10 GROUND (ADDITIONAL REQUIREMENTS)

A. Electronic Equipment MDF, IDF and Terminal Rooms and Closets

1. Terminal Equipment Ground Bus (TEGB) - Provide a wall mounted TEGB ground bus in each MDF location. Also provide a TEGB where two or more equipment racks and/or terminal blocks are provided in each IDF. The TEGB ground bus shall be copper ¼-inch by 2-inches (nominal) by 12-inches long (minimum). Install the TEGB on the wall with a minimum of two "stand-off" electrical insulators. Drill and tap the ground bus and provide bolted type ground lugs for connection of each ground conductors size #10AWG - #1AWG. Provide four spare unused ground lugs on the TEGB.
2. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the building main ground reference bus. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.
 - a. Provide the same ground connections from the equipment rack ground bus where only a single equipment rack occurs in the IDF location.
3. The ground conductor required from the TEGB to the building main ground reference bus may be looped and connected between separate TEGB ground bus locations if all of the following conditions are met.
 - a. The ground conductor is increased to 1.5-inch conduit with 1#2/0AWG copper insulated and the total end to end length does not exceed 300-feet.
 - b. The building exceeds two floors in height.
 - c. Not more than four TEGB buses are connected to the same "looped" ground conductor.
 - d. The TEGB ground conductor is continuous (not cut, spliced or broken) along its entire length.
 - e. The TEGB ground conductor is connected to the TEGB ground buses with a UL listed "Exothermic" welding process.

B. Equipment Racks:

1. Provide a separate 12AWG copper stranded green insulated ground conductor from each individual equipment element in the rack to the respective rack ground bus.
2. Provide a separate #8AWG copper insulated ground conductor from each equipment rack ground bus to the TEGB terminal equipment ground bus located in the same space.
3. Where only one equipment rack is installed, provide 1.25-inch conduit with 1#1AWG copper insulated ground homerun conductor from the equipment rack ground bus homerun to the building main ground reference bus and provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB or single equipment rack

ground bus (as applicable), to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.

4. Provide 1.25-inch conduit with 1#4AWG copper insulated ground conductor from each wall mounted fiber interface cabinet to the respective TEGB ground buses.
 5. Provide a 1#10AWG copper insulated ground conductor connecting in a continuous loop to all miscellaneous cable trays and metal support equipment located in the terminal closet or room and connect to the TEGB ground bus.
- C. Telephone/Voice Terminal Blocks:
1. Provide a separate #8 copper insulated ground conductor from each terminal block section ground bus to the TEGB terminal equipment ground bus.
 2. Provide a separate #6 copper insulated ground conductor from the terminal room/closet to the lightning ground system.

3.11 WALL MOUNTED FIBER INTERFACE CABINET - WMIC

3.12 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. General
1. Fiber optic and copper wire cables shall be identified in each manhole, pull box, equipment rack, patch panel and computer workstation outlets.
 2. Infrastructure documentation, identification labels and color coding shall comply with ANSI/TIA/EIA-606A Administration Standard for Telecommunications Infrastructures, Class-1 thru Class-4. Provide management software MS-Windows-based single user license, with all as-built data entry documentation information complete.
- B. Identification tags shall include the following information:
1. Cable name as indicated on Drawings (i.e., HV1, F4, MSB3 etc.).
 2. Installation month and date (i.e., 3/92, 4/78 etc.).
 3. Conductor size conductor type (i.e., loose tube fiber; #24AWG ScTP Category 5, 200-pair, telephone/voice etc.).
 4. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, Rack #21, etc.)
- C. Identification Tags
1. Tags shall be 1/8-inch thick 98% lead, approximately 2-inch square with chamfered corners. Two holes shall be drilled for attachment to primary cable. Lettering shall be 1/8-inch high, engraved or die stamped. Attach tags to primary cables with two #14AWG (THWN insulated) solid copper conductors "twist-tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.
 2. Alternate identification tags, at the CONTRACTOR'S option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tag with black alphanumeric characters sets. Characters shall be approximately .25-inch high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey.

- D. Equipment and outlet naming identification and color-coding shall comply with ANSI/EIA/TIA latest revision.
1. Naming method for equipment, outlets and cables; where a position in the naming string is unused, provide multiple "****" symbols.
Typical naming string "ADM-02-1141-PP17-1271"
 - a. "ADM" - Abbreviated Building Name or Number (i.e., Administration, B127, etc.)
 - b. "02" - Floor Level #2 or as applicable.
 - c. "1141" - Outlet, Equipment or Terminal Room/Closet name or room number as applicable.
 - d. "PP17" - Terminal Rack Patch Panel Identification.
 - e. "1271" - Individual Outlet or Port Identification.
 2. Connecting hardware color coding shall be as follows:
"Green" - Main central terminal location for entire site.
"White" - Distributed terminal locations other than the main terminal.
"Blue" - Horizontal wiring hardware systems for workstations.
- E. Provide warning nameplates on fiber optic patch panels, fiber optic outlets, and any location where fiber optic cables are terminated. Minimum 1/8-inch high engraved/etched letters.
"WARNING - LASER LIGHT SOURCE. DO NOT LOOK DIRECTLY AT OUTLET OR FIBER CABLE ENDS. RISK OF SEVERE EYE DAMAGE OR BLINDNESS".

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SECTION 27 41 16
AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The Invitation for Bids, Instruction to Bidders and General Conditions of the Contract including any supplementary conditions apply to all work under this Section.
- B. The Contractor acknowledges and warrants that he has closely examined all the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete the work in the time allotted for the contract sum as accepted by the CM and AV Consultant, and that they include all work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the work in full compliance with all applicable Codes, Laws, Ordinances, Rules and Regulations,
- C. Execution of the Contract by the Contractor or his Representative and warranty that the Contractor has carefully examined the Contract Documents, and represents and warrants that the Contractor is thoroughly familiar with the nature and location of the work, the site, the specific conditions under which the work is to be performed, and all matters which may in any way affect the work or its performance. The Contractor further represents that as a result of such examinations and investigations, the Contractor has thoroughly reviewed and understands the Contract Documents and their intent and purpose, and is familiar with all applicable Codes, Ordinances, Laws, Regulations and Rules as they apply to the Work and that the Contractor will abide by same.
- D. Claims for additional time or additional compensation as a result of the Contractor's failure to follow the foregoing procedure and to familiarize it with all local conditions and the Contract Documents will not be permitted.
- E. Related Work Specified Elsewhere:
 - 1. All Division 1 Specification Sections apply to this Section.
 - 2. Power, signal conduits and back-boxes provided and installed under Division 26; except loudspeaker back-boxes and specialty back-boxes provided under this work for installation under Division 26.

1.02 INSTRUCTIONS TO BIDDERS

- A. Definitions:
 - 1. Bidding documents include the proposed Contract Documents, which consist of the Project Specifications herein and the associated AV Category Drawings.
 - 2. A bid is a complete and properly signed proposal to do the work as described in the Contract Documents, for the sums stipulated therein, submitted in accordance with the bidding documents.
 - 3. The work includes all tasks necessary to complete the Contract as described in the Contract Documents.
 - 4. A Bidder is a person or entity that submits a bid for coordinating and/or performing all the work as described in the Contract Documents.

5. A Sub-Bidder is a person or entity who submits a bid to a Bidder for materials, equipment, and/or labor for a portion of the work.
 6. The Owner is Compton Community College District and its affiliates and subsidiaries.
 7. The CM (CM) - Representative.
 8. The Architect is DLR Group.
 9. The AV Consultant is Plan Net Consulting.
- B. Bidding Documents:
1. Copies:
 - a. The CM will issue bidding documents directly to the Bidders.
 - b. Bidders shall be responsible for providing copies of the bidding documents to Sub-Bidders to solicit services to be Sub-Contracted.
 - c. In making copies of the bidding documents available on the above terms, the AV Consultant does so only for the purpose of obtaining bids on the work and do not confer a license or grant permission for any other use of the bidding documents.
 2. Interpretation or Correction of Bidding Documents:
 - a. Bidders and Sub-Bidders shall carefully study and compare the bidding documents with each other to the extent that it relates to the work for which the bid is submitted, and shall promptly notify the AV consultant of any ambiguity, inconsistency, or error which they may discover.
 - b. Bidders and Sub-Bidders requiring clarification or interpretation of the bidding documents shall make a request to the AV Consultant through the General Contractor at least 5-working days prior to the date of receipt of bids. Requests for information (RFI) shall be written and faxed to the CM. No questions will be answered by telephone.
 - c. The AV Consultant will make clarifications by addendum and/or by written response if deemed necessary.
 3. Addenda:
 - a. Each Bidder shall ascertain, prior to submitting a bid that the bidder has received all addenda issued, and the bidder shall acknowledge their receipt in the bid.
 - b. Consideration of bids
 4. Rejection of Bids:
 - a. The CM and the AV Consultant shall have the right to reject any or all bids and to reject a bid not in compliance with Bidding Procedures and Requirements, no accompanied by data required by the bidding documents, or in any way incomplete or irregular.
 - b. The CM and the AC Consultant shall also have the right to reject any or all bids when, in their judgment, it is in their best interest to do so.
 5. Acceptance of Bid:
 - a. The CM and the AV consultant will be the final judge of which bid is accepted.
 - b. The CM and the AV consultant shall have the right to waive informalities or irregularities in a bid received and to accept a bid which, in their judgment, is in their best interest.

C. Related Documents

1. Drawings and general provisions of the Contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this Section.
2. Audio-visual Drawings provide additional General Construction Requirements.
3. Exhibit B: Major Equipment and Approved Manufacturers List.

1.03 SUMMARY OF WORK

- A. The AVC shall provide the AV system designs using the Owner furnished Contractor Installed (IOFCI) to provide a complete turn-key solution with the equipment specified and additional parts required for a functional system.
- B. Classroom Type 1 — Short Throw Projector
1. The audio-visual systems shall provide capability for presentations, and both audio and video playback. The following describes the equipment and capabilities of this room.
 2. Video reproduction shall be via one wall-mounted 3300 lumen projector (800, 16:10 aspect ratio). The image shall be projected on an OFE whiteboard with the image filling the whiteboard top to bottom and the width as much as possible.
 3. Stereo audio sources shall be summed and reproduced via four recessed loudspeakers in the drop tile ceiling. Audio content shall be a monaural output and evenly distributed through-out the ceiling using a 70V audio amplifier built into the switcher; the speakers shall be secured with a minimum of one seismic wire on each speaker to the hard-lid ceiling above the drop tile ceiling.
 4. There shall be an Assisted Listening System (ALS) in each classroom with an infrared (IR) radiator and IR receivers (Stethoscope receiver, and Neck Loop for a T-Coil) for use by students with a hearing impairment.
 5. There shall be one wireless lapel type microphone for use in the classroom. This shall be used for capturing the Instructor's voice for the ALS system and voice reinforcement for soft spoken instructors.
 6. Sources shall include inputs with a HDMI and VGA/stereo audio cables for laptops and other portable equipment like a document camera if available.
 7. There shall be one cable cubby in the AV rack/cart with one set of multimedia input cables (HDMI, VGA/stereo audio cables). These shall be located on the top of the rack/cart; the location in the top of the rack/cart shall be confirmed with the client and the cut out opening for the cubby shall be provided by the AVC.
 8. There shall be a rolling AV rack/cabinet with doors front and back and a slim power strip with basic surge protection to house the AV equipment, cable cubby with control panel.
 9. Control of the AV equipment and projector in the room shall be via control system in the AV switcher/scaler and through the control panel in the top of the cable cubby. The control system shall control source selection, ON/Off functionality for the complete system from a single button, room volume control, microphone volume level, and display image freeze if available. When a source button is pressed on the control panel, the displays shall turn on, switch to the appropriate input. Sources that have additional functionality or messages shall have a pop-up window with additional controls or text for

the button that was pressed (Laptop — HDMI, Laptop VGA, Help Desk) to guide the user for additional action.

B. Classroom Type 2— Ceiling Mounted Projector

1. The audiovisual systems shall provide capability for presentations, and both audio and video playback. The following describes the equipment and capabilities of this room.
2. Video reproduction shall be via one ceiling-mounted 5000 lumen projector (1280 x 800, 16:10 aspect ratio). The image shall be projected on an OFE whiteboard with the image filling the whiteboard top to bottom and the width as much as possible.
3. Stereo audio sources shall be summed and reproduced via four recessed loudspeakers in the drop tile ceiling. Audio content shall be a monaural output and evenly distributed through-out the ceiling using a 70V audio amplifier built into the switcher; the speakers shall be secured with a minimum of one seismic wire on each speaker to the hard-lid ceiling above the drop tile ceiling.
4. There shall be an assisted listening system (ALS) in each classroom with an inferred (IR) radiator and IR receivers (Stethoscope receiver, and Neck Loop for a T-Coil) for use by students with a hearing impairment.
5. There shall be one wireless lapel type microphone for use in the classroom. This shall be used for capturing the instructor's voice for the ALS system and voice reinforcement for soft spoken instructors.
6. Sources shall include inputs with a HDMI and VGA/stereo audio cables for laptops and other portable equipment like a document camera if available.
7. There shall be one cable cubby in the AV rack/cart with one set of multimedia input cables (HDMI, VGA/stereo audio cables). These shall be located on the top of the rack/ cart; the location in the top of the rack/cart shall be confirmed with the client and the cut out opening for the cubby shall be provided by the AVC.
8. There shall be a rolling AV rack/cabinet with doors front and back and a slim power strip with basic surge protection to house the AV equipment, cable cubby with control panel.
9. Control of the AV equipment and projector in the room shall be via control system in the AV switcher/scaler and through the control panel in the top of the cable cubby. The control system shall control source selection, ON/Off functionality for the complete system from a single button, room volume control, microphone volume level, and display image freeze if available. When a source button is pressed on the control panel, the displays shall turn on, switch to the appropriate input. Sources that have additional functionality or messages shall have a pop-up window with additional controls or text for the button that was pressed (Laptop — HDMI, Laptop VGA, Help Desk) to guide the user for additional action.

C. Conference Rooms

1. Conference Rooms shall allow the end users to conduct meetings and presentations; there shall be sources such as a laptop, and other auxiliary portable equipment.
2. The Contractor shall provide and install one wall mounted 55-inches consumer LED flat panel display with a resolution of 1920 x 1080 (16:9) in the conference room.
3. Stereo audio sources shall be summed and reproduced via two loudspeakers mounted in the ceiling. Audio content shall be a monaural output and distributed throughout the

ceiling using a 70V audio amplifier built into the switcher; the speakers shall be secured with a minimum of one seismic wire.

4. Audio and video from inputs in the flip-top cubby on the rack/cabinet shall be reproduced via the ceiling mounted speaker.
5. There shall be an assisted listening system (ALS) in the conference room with an inferred (IR) radiator and IR receivers (Stethoscope and Neck Loop for a T-Coil) for use by people with a hearing impairment.
6. There shall be a rolling AV rack/cabinet with doors front and back and a slim power strip with basic surge protection to house the AV equipment, cable cubby with control panel.
7. One flip-top cable cubby shall be mounted into the rack/cabinet in the conference room and shall connect laptop computers, and other auxiliary video equipment. The Contractor shall coordinate the integration of the cubbies into the rack/cabinet with the Architect and Owner. The cable cubby connections shall be VGA with stereo audio, and HDMI connection. Power and data connections shall also be available at the cable cubby.
8. The opening in the rack/cabinet top for the flip top cable cubby shall be provided by the AVC. Before cutting the openings in the table top the Contractor shall provide a Drawing of the table top indicating the cubby location for review and signoff by the CM and Owner. Before actually cutting the Contractor shall markup the cubbies locations on the table top before making the first cut in the table top for a final review by the client.
9. One set of multimedia input cables (HDMI, VGA/stereo audio) shall be available for connection of auxiliary portable devices such as laptop computers in the room.
10. Control of the AV equipment and projector in the room shall be via control system in the AV switcher/scaler and through the control panel in the top of the cable cubby. The control system shall control source selection, ON/Off functionality for the complete system from a single button, room volume control, microphone volume level, and display image freeze if available. When a source button is pressed on the control panel, the displays shall turn on, switch to the appropriate input. Sources that have additional functionality or messages shall have a pop-up window with additional controls or text for the button that was pressed (Laptop — HDMI, Laptop VGA, Help Desk) to guide the user for additional action.

D. Paging System

1. There shall be a paging system speaker provided by the AVC and installed by the GC. The paging speakers shall be installed in the Lobby, and hallways (public and office areas) on the first and second floors. Refer to Sheets T2.01 and T2, 02 for the approximate speaker locations.
2. The headend of the paging system shall be in the IDF room with the telephone systems. The AVC shall confirm the rack location and the connection to the telephone system for a line level output for the mixer/DSP unit. The AVC shall work with the Colleges' IT Department to set-up and test the connection to the telephone system, and test the paging levels in all areas.

1.04 SCOPE

- A. Supply and install sound and video systems including all apparatus and equipment, wiring, termination, labor, and services required to provide systems as specified and shown on Drawings.
- B. If equipment has been discontinued or at “end of life”, the equipment shall be substituted with the newest like model available from the same Manufacturer. If a different Manufacturer or model of equipment is to be substituted, the substitution must be reviewed by the Consultant and Client for approval.
- C. Supply and install any incidental equipment needed in order to meet the Functional Requirements stated herein and on Drawings. This shall include all support and restraint for the fixed loudspeakers and projection equipment.
- D. Set up and adjustment of specified hardware and software.
- E. Furnish all test equipment and the services of the Project Engineer and the Project Manager to assist the CM’s Representative in the acceptance testing.
- F. Make any adjustments to any part of the system, including the re-aiming of loudspeakers, which may be found necessary during the acceptance testing.
- G. Provide training in the operation of the systems to the person or persons selected by the CM.

1.05 COORDINATION:

- A. Schedule installation operations in sequence required in order to obtain best completion results.
- B. Coordinate the procurement and installation of the projection screens, projector mounts and all loudspeakers with the CM and Owner.
- C. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
- D. All specialty Sub-Contracting including coordination of all Telecommunications lines with other Sub-Contractors and equipment as shown on the Contract Documents to be coordinated by the Contractor.

1.06 EQUIPMENT AND MATERIALS

- A. The Contractor shall verify characteristics of elements of interrelated equipment specified under this Section are compatible; coordinate work having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- B. By making requests for substitutions, the Contractor:
 - 1. Represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified.
 - 2. Represents that he will provide the same warranty for the substitution that the Contractor would for that specified.
 - 3. Certifies that the cost data presented is complete and includes all related costs under this Contract, and waives all claims for additional costs related to the substitution which may later become apparent.
 - 4. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects, including, but not limited to, in

full compliance with all applicable Codes, Laws, Ordinances, Rules, and Regulations and completion in the time allotted for the Contract sum as accepted by the CM and AV Consultant.

1.07 SCHEDULE

- A. Within 10-calendar days of the receipt of the "Notice to Proceed" the Contractor shall prepare and submit for approval, in accordance with the general conditions, a schedule which shall include, but is not limited to, the following:
1. Submission of Shop Drawings, samples and layouts for all items described herein.
 2. Start and Completion date(s) for field installation work.
 - a. Installation date(s) of all wires and cables in conduits and required cable trays.
 - b. Date when fully-operational equipment racks will be fully tested and ready for Consultant's observation.
 - c. Delivery date(s) of all systems and subsystems to the project site.
 3. Start and completion date(s) for shop fabrication work.
 4. Date of submission of samples for approval by the architect of all finishes/materials which will be visible to the public. Refer to Part 1 paragraph 1.8 entitled "Submittals" for additional information.
 5. Programming of all remote control and digital signal processing driven devices.
 6. Completion dates(s) for the following tests:
 - a. Performance tests on all individual AT components as they are received from the Manufacturer in the Contractor's shop.
 - b. Performance tests on completed assemblies and subassemblies assemblies, including all racks in the Contractor's shop,
 - c. Performance tests on the completed systems as a whole prior to shipment to the Project Site.
 - d. General Performance Testing of systems at the Project Site.
 7. Completion dates for the following shop and field observations.
 - a. Shop fabricated assembly and subassembly observation.
 - b. Substantial completion observation at the ProjectSite.
 - c. Final acceptance observation at the ProjectSite.
 8. Submission date for operating, maintenance manuals, As-Built Drawings, documentation and closeout materials.
- B. In the event the Contractor wishes to deviate from the schedule once it is established and approved, he may do so only after receiving written approval from the CM.

1.08 SUBMITTALS

- A. All submittals shall be in accordance with the general provisions of the Contract, including general and supplementary conditions and other Division 1 Specification Sections.
1. AV consultant will not review partial submittals.
 2. AV consultant will review up to two submittals of any one submittal topic.

- B. Substitutions of equal equipment beyond the alternatives listed will be permitted only in accordance with Division 1. If a requested substitution requires a change in any of the Contract Drawings, a revised Drawing must be submitted as part of the substitution request. If an alternative listed is discontinued prior to installation, the Contractor shall submit a substitution request to provide the Manufacturer's replacement model. The AV Consultant shall be the final judge of the acceptability of substitutions.
- C. All Drawings shall be clear and legible. The minimum text size for all Drawings shall be 1/8-inch high.
- D. Post Award Submittals: submit within 60 days of award.
 - 1. Submit electronic reproducible Drawings (as .dwg and .pdf), documents (as .pdf) and software as per Manufacturer's directions of the following:
 - a. A statement of Sub-Contractors, Franchises, Distributorship, Dealerships, Arrangements and Agreements with Manufacturers of equipment to be used for this work.
 - b. Complete bill of quantities, including all material, components, devices and equipment required for this work. The bill of quantities shall be tabulated respective of each and every system as specified, in the order of the Specification Section 2 below, and shall contain the following information for each item listed:
 - 1) Quantity
 - 2) Description
 - 3) Manufacturer's name and model number
 - 4) Manufacturer's specification sheet
 - 2. Samples of approval by the Architect of all finishes/materials which will be visible to the public. Including at least receptacles and controls with associates trim plate and each type of loudspeaker baffle and/or grille.
 - 3. Schedule for work as described herein showing all major milestones.
 - 4. Floor Plans, at scale of Contract Documents, showing the locations throughout the Project of all receptacles, conduits, wireways, trays, pull boxes, junction boxes, equipment racks equipment and other devices with appropriate designations and fill.
 - 5. Riser diagrams, showing all elevations, room numbers, conduit sizes, types and fills, box sizes and types, devices, equipment and rack designations.
 - 6. Functional Diagrams: single-line block diagram showing interconnection of all components, receptacles, terminal blocks, controls, transformers and loudspeakers in addition to the active elements. Include terminal and cable numbers, all system and component labels. Show detailed system component information including but not limited to Manufacturer's name, model number, any specialized part number option and all input and output connection information, for each piece of equipment. No Drawing Codes shall be permitted. Mount one full-scale original or photograph (not blueprint) copy behind acrylic in the control booth for each system.
 - 7. Equipment rack elevation Drawings scaled (1½-inch = 1-foot-0-inch or larger):
 - a. Front Elevations: include equipment designation, Manufacturer's name, model number, rack location and rack designation.
 - b. Rear Elevations: include AC power wireways and route of wiring harnesses.

8. Samples for approval by the Architect of all finishes/materials that will be visible to the public including at least receptacles and controls with associated trim plate and each type of loudspeaker baffle and/or grille.
 9. Cable schedules and run sheets, associates with each equipment rack and/or any isolated piece of equipment or device, including cable designation, type, Manufacturer and Manufacturer's type number, wire color, device and terminal designation and device location, keyed to both the system block diagram and Equipment Rack Elevation Drawings.
 10. Contractor fabricated items, Detailed Drawings showing all components, devices and equipment, including dimensions, component values, terminal designations, types, locations, Manufacturer's name and model number.
 11. Loudspeaker cluster and monitor loudspeaker supports stamped and signed by an Engineer licensed in the Project State. Include all loads, location of attachment to building structure, complete layout of all components, devices and equipment, including dimensions, methods of assembly, and connections to supporting construction, details of hardware, locations, Manufacturer's name and model number. All design calculations, loads, etc. shall be shown. Drawings shall be ¼-inch = 1-foot-0-inch scale minimum. Permissible scales shall be ¼-inch, ⅜-inch, 1-inch, 1½-inch, and 3-inch = 1-foot-0-inch and full scale.
 12. A bound volume or volumes of Comprehensive Specifications for all material, devices, components and equipment selected for use in this Section, whether modified or not, provided as required under "Post Award Submittals" above.
 13. Control panel Layouts: Developed Drawings of all control system panel layouts.
- E. Digital Signal Processor (DSP) System Submittal for CM Review:
1. Prior to programming the Digital Signal Processing (DSP) system, the Contractor shall submit Shop Drawings per the Project Standards showing all screen layouts and control descriptions of all system functions to the CM for review and comment prior to actual programming of the system. Shop Drawings shall include screen layouts of the DSP software "control pages" for all "configuration-presets" and "parameter-presets". Submit electronic versions of the DSP software to the Consultant for review and approval. The Contractor shall incorporate all CM comments into the programming of the systems.
 2. Prior to delivery of the systems to the job site, the Contractor shall demonstrate fully functioning systems in the Contractor's facilities that include the DSP system programming. This demonstration shall coincide with the CM's Representatives observation of completed sub-assemblies (Refer to Part 3 paragraph entitled "System Performance Tests"). The CM will review and comment upon the remote control programming, and the Contractor shall incorporate all CM comments into the programming of the systems.
 3. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the CM shall have a review period of 30-days to observe the operation of the DSP system. At the end of this review period, the CM may request programming changes relating to the look and feel of the operation pages or the functionality of commands. The Contractor shall make these changes prior to acceptance of the systems.

F. Control System Submittal for CM Review:

1. Prior to programming the remote control system, the Contractor shall submit Shop Drawings per the Project Standards showing all control screen layouts, graphical user interfaces (GUI) and control descriptions of all remote control system functions to the CM for review and comment prior to actual programming of the system. Submit in native file format and hard copy form. Shop Drawings shall include control screen layouts of the touch panel pages for each venue, web page layouts (as required in Part 2 below). Submit electronic versions for CM review. The Contractor shall incorporate all CM comments into the programming of the systems.
2. Prior to delivery of the systems to the job site, the Contractor shall demonstrate fully functioning systems in the Contractor's facilities that include the remote control programming. This demonstration shall coincide with the CM's Representative observation of completed sub-assemblies (Refer to Part 3 paragraph entitled "System Performance Tests"). The CM will review and comment on the remote control programming submittal, and the Contractor shall incorporate all CM comments into the programming of the systems.
3. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the CM shall have a review period of thirty days to observe the operation of the remote control system. At the end of this review period, the CM may request programming changes relating to the look and feel of the remote control panels or the functionality of commands. The Contractor shall make these changes prior to acceptance of the systems.
4. Digital Signal Processing and control system programming files, touch panel, and other control page and Graphical User Interface layouts in native file format and hard copy form,

G. Shop Test Statement Submittals:

1. Submit electronically - photographs and state of the following prior to shipping fabricated equipment racks to Project site:
 - a. A bound volume, or volumes, of results of performance tests and adjustment data, including all test procedures specified in Part 3 paragraph Reference source not found entitled "System Performance Tests". Example shop test statement submittal templates are available from the AV consultant upon request.
 - b. Submit a written request for equipment rack observation certifying that equipment racks are completely assembled, tested and ready for inspection.
 - c. Detailed interior and exterior photos of assembly supporting claim for readiness for inspection.

H. Final Submittals: Submit the following Record Drawings developed from the final "As-Built" systems:

1. Two copies and one reproducible of each of the Block Diagrams, Plans, Risers, Patch Bay Drawings, Rack Elevations, Cable Schedules and Detail Drawings. All reproducible Drawings shall be submitted on CD-ROM.
 - a. One complete set of Functional diagrams 1/2 size Drawings.
 - b. One additional set of Rack Elevation Drawings and sheets provided in the Drawing package.

2. No more than 30-days after Acceptance Testing, submit two copies of each of the following equipment cut sheets and manuals prior to, and as a Requirement of, CM acceptance of the work of this Section:
 - a. Equipment operating instructions; complete, comprehensive instructions for the operations of all Contractor-fabricated devices and equipment items provided as part of the work of this Section.
 - b. Manufacturer's cut sheets, installation, operating and service information including schematic diagrams for each item of equipment furnished. Order the equipment manuals in the order of the Specifications. Provide tabs between each equipment manual. Provide a detailed index at the front of each manual indicating Specification reference number. Manufacturer's trade name, model number and part description. Provide two copies to the CM after they have been reviewed and approved by the AV Consultant.
 - c. Printed material within Contractor-fabricated equipment and systems operating manuals shall be bond paper copies, offset or letterpress printed. Drawings, charts and graphs shall be bond paper offset printed. The Systems Contractor-fabricated equipment instruction manuals shall be composed using a single, consistent visual format and writing style; text shall be derived from Component Equipment Manufacturer's instruction manuals and may include reproductions of artwork and other materials.
3. Submit two copies of each of the following schedules, lists, and data prior to, and as a Requirement of, CM acceptance of the work of this Section:
 - a. All source code for any Contractor provided or programmed equipment on CD-ROM.
 - b. Final bill of quantities; complete bill of quantities all material as delivered, including a separate schedule of portable equipment.
 - c. Equipment schedule; complete, final schedules of equipment and devices provided in each room, by room number and name.
 - d. Performance, test and adjustment data; comprehensive documentation of all performance verification and correction procedures and measurements, including raw and equalized house curves and equalizer settings.
 - e. Maintenance and spare parts schedules; a comprehensive tabulation of equipment, devices, miscellaneous parts and maintenance items, including Manufacturer's name, address, model number, systems use and miscellaneous information,
 - f. No more than 30-days after Acceptance Testing, provide one copy of the following:
 - 1) Certificates; any and all licenses, certificates of operation and/or compliance as required.
4. The system will not be accepted until these documents are reviewed and approved by the CM's Representative.

1.09 QUALITY ASSURANCE

- A. Unless otherwise stated, all electrical, electronic and optical equipment shall be a product of firms regularly engaged in the manufacture of electrical, electronic or optical equipment. The equipment shall be the latest model or type offered which meets the applicable Specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited and should not be submitted for review. It shall be the Contractor's responsibility

to provide the AV Consultant with information regarding discontinued products listed as alternatives in the Specification. If an alternative listed is discontinued prior to installation, the Contractor shall submit a substitution request to provide the Manufacturer's replacement model.

- B. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated shall be comparable to professional equipment produced by specialized Manufacturers of the trade involved and shall be verified by observation. Only firms having 10 years' experience in all aspects of the fabrication and installation of similar systems shall be allowed to perform the work.
- C. All materials and products shall be new and of professional quality. Unless specifically stated in the Drawings or Specifications, no existing or pre-owned materials shall be installed.
- D. The work specified herein, and in each of the allied sections, shall be accomplished by a single Contractor experienced in the design, fabrication, installation, checkout and warranty contract management of systems such as those described in each Section. This Contractor shall have complete responsibility for the systems described herein and shall be the single Contract point for the Architect, the AV Consultant and/or the CM with respect to all work specified herein.

1.10 WARRANTY AND SERVICE

- A. The Contractor shall warrant the installation free of faulty workmanship.
- B. All components, including solid-state devices, warranted free of defects for a period of 1-year from date of final acceptance. This minimum warranty provision shall not diminish the terms of individual Equipment Manufacturers' warranties.
- C. Paint and exterior finishes, fuses and lamps excluded from above warranties except when damage or failure results from defective materials or workmanship covered by warranty.
- D. Provide Maintenance Service for a period of 1-year after acceptance of installation. Service to consist of at least two semiannual visits to the site software updates, and equipment adjustments. These visits should be coordinated with CM or Representative.
- E. Service request response time: Provide 2-hour via telephone / email, with 24-hour on-site technical response time. Provide a Technician on call from 7 a.m. to 9 p.m. 5-days a week.
- F. All repairs must be completed within 10 business work days. If repairs cannot be completed within 10-working days, a replacement/loaner must be provided. If it cannot be resolved within the 10 days, the CM or CM Representative will have the option of getting it repaired with the Contractor covering the costs.

PART 2 – PRODUCTS - N/A

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The following Installation Requirements shall govern the design, fabrication and installation of the system(s) specified herein. In case of a discrepancy between these overall System Standards and the individual Equipment Item Specifications, the latter shall govern:
 - 1. The equipment specified shall be installed according to Standards of good human engineering practice and the conditions specified herein.

2. Workmanship on the installed systems shall be of professional quality, best commercial practice and accomplished by persons experienced in the Techniques and Standards of the particular industries involved.
 3. The Specifications describe required performance. The Specifications with the Contract Drawings indicate a general design; it is the intention of the Specifications that the Contractor will supply from his background of experience and knowledge the necessary supporting details; for example, the implementation of specific components into functioning sub-systems.
 4. In general, the Drawings show dimensions, positions, and kind of construction. The Specifications describe materials, qualities and methods. Any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both. In case of differences between the Drawings and the Specifications, the decision of the CM's Representative shall govern. Work not particularly detailed, marked or specified shall be construed to be the same as similar parts or areas that are detailed, marked, or specified.
- B. Equipment markings shall present only needed information and be readable from the Operator's normal work position. These markings shall be designed to minimize ambiguous interpretation.
 - C. Control panels shall be designed to reduce chances of human error and controls shall be natural and consonant with normal operator expectations.
 - D. All control consoles and their panel mountings shall be provided with the necessary controls, indicators and switches, etc., as outlined in the pertinent sections of this Specification. The grouping of these facilities shall be in accordance with the Associated Drawings and shall, in all cases, be arranged to present an orderly, functional appearance. The layout of controls shall be such that priority of accessibility shall be given to those facilities which frequently require attention.
 - E. The total design of the system shall simplify the Operator's task and insure maximum performance and reliability while minimizing possibilities for human error and providing a comfortable environment for the operator during operation.
 - F. At the operational level (i.e., patch panels, AV equipment receptacle boxes, etc.) all receptacles shall be clearly marked by function and number. When there are multiples of the same function for example, a given microphone line may appear at several locations, the same label shall be shown at each location.

3.02 THE CONDUIT SYSTEM:

- A. The AV Category Drawings indicate the number, type and location of the receptacle. Wire and Cable Requirements and Equipment Room layouts, which are the responsibility of the Contractor. The conduit diagrams indicate schematically the functions served by the conduit system. Also, the conduit diagrams may indicate the locations at which functions are served at several locations in the facility. See the general installation notes for additional Information and Requirements as shown on the AV category Drawings.
- B. The Electrical Contractor is bound to provide the conduit system shown on the AV Category Drawings as part of the Base Building Contract.
 1. If any portion of the conduit installation is concurrent with the AV Contract, the Contractor shall inspect the work at appropriate times during construction and report

any discrepancies to the architect and CM in writing. The Contractor shall coordinate the exact location of intermediate collector boxes behind the equipment rack with the Electrical Contractor.

2. The Electrical Contractor is bound to verify continuity of all conduits as described in the AV Category Drawings with a yellow pull string.
- C. The Contractor shall be responsible for supplying any additional conduit that may be required to complete the system installation in accordance with the Drawings.
- D. It shall be the responsibility of the Contractor to obtain the exact location of any pull boxes, "LBs" or other intermediate locations from the Electrical Contractor.
- E. The Contractor shall also verify that conduits are adequate for the wiring and functions specified. If the Contractor substitutes the specified wiring the Contractor shall bear the sole responsibility for reengineering the conduit system,
- F. The Contractor shall field verify all back box installation conditions on site and shall size connection panels as described below. Notify the CM and AV Consultant of any discrepancies between AV Drawings and installation conditions.
 1. Surface Mounted Back Boxes: Connection panels shall be sized to match the outer edges of the installed back box and shall have smooth edges.
 2. Recessed Mounted Back Boxes: Connection panels shall be sized to overlap the outer edges of the installed back box by 1-inch in both horizontal and vertical directions and shall be installed tightly against the wall surface finish,
- G. Each conduit shall contain wires or cable of the same signal level or the same type of circuitry only. Each separate service level designation shown on the AV conduit riser shall be run in their respective, separate conduits and all conduit landings in backboxes or equipment racks shall be grouped by service level.
- H. Ground power conduits to the power system ground. Do not connect power system conduits to the racks or to the audio system ground.

3.03 EQUIPMENT RACK ASSEMBLIES:

- A. General:
 1. Equipment rack shall be completely assembled, tested and programmed in the Contractor's shop. No rack assembly shall be performed at the Project Site. After the equipment rack is tested the Contractor shall notify the CM's Representative in writing that the equipment rack assemblies are ready for observation and approval. Allow adequate time for any modifications necessary to satisfy the Contract Drawings and Specifications.
 2. Use rear and mid rails for intermediate terminations. Maintain accessibility to the rear of the equipment.
 3. Mid rails must be used to support equipment weighing more than 50 pounds.
- B. Wiring Harnesses:
 1. Equipment rack wiring shall be "Harness" style. "Point to Point" rack wiring is not acceptable. The individual wiring harnesses shall be located at the rear of the equipment rack on the sides and individual pairs of cable shall be broken out on to lacing bars to the back of the equipment to the connectors.

2. Electrical service levels shall not be mixed in an individual harness. It is the intent that there will be a separate harness for each electrical service level.
 3. Great care shall be exercised to keep low level signal harnesses separated from the AC power lines and high level signal harnesses.
- C. Equipment Labels:
1. Rack-mounted equipment shall be labeled on front and back, as to function using engraved black/white laminated plastic blocks. For example: LEFT HI- FREQ AMPLIFIER or CENTER EQUALIZER.
 2. Use permanent professional quality labels such as "Gravelply" or approved equal. Stick-on strip labels such as those from Dyno or Brother are not acceptable.
- D. Internal A/C Receptacles:
1. Maintain grounding as described in the herein.
 2. Locate all internal AC receptacles on the left side of the rack and all harnesses on the right side of the rack. In the event that there are two equipment racks side by side locate the AC receptacles in the middle of the equipment racks and the wiring harnesses to the outer sides.
- E. Installation:
1. No equipment may be installed prior to the following:
 - a. The AV Consultant has performed the AV equipment rack observation in the Contractor's shop.
 - b. Any and all punch list items described as 'minimum to enable rack delivery to site' have been addressed, proof has been submitted to AV Consultant and AV Consultant has approved rack delivery to site.
 - c. Notice has been filed with the CM, the Architect, and the AV Consultant that a 'dust-free' environment has been achieved in the project in all areas where audiovisual system equipment is to be installed. Dust-free shall be defined as follows: all floor, wall, ceiling construction, millwork, finishes (including paint), carpet, hardware, electrical, and HVAC is absolutely complete (and tested and fully operational in the case of electrical and HVAC systems) before AV equipment racks may be delivered to the site.
 2. All stationary equipment rack(s) shall be secured to the building structure to meet Seismic and Code Requirements.
 3. Great care shall be exercised to keep low level signal lines separated from the AC power lines and high-level signal lines.
 4. All audio field lines entering the equipment rack must be connected to equipment. Video field lines may be connected directly to the switcher or patch bays. In the event that a patch bay with an E3 or E90 connectors is used, the patch bay may serve as the terminal block. This will also facilitate the testing of the systems in the Contractor's shop.
 5. All connections of lines at terminal blocks, as well as at signal receptacles, shall be mechanically secured and then soldered. No unsoldered connections shall be permitted. Where lines approach the racks and terminal blocks they shall also be mechanically

anchored at the rack, and provided with sufficient slack length to avoid strain, abrasion or wear.

F. Wiring and Cabling:

1. Extreme care must be taken to physically segregate and separate all high level lines from lower level lines,
2. Control cables and power distribution wiring shall not be installed adjacent to signal cables. Power distribution cabling shall be on the opposite side from signal wiring in equipment enclosures and shall be uniformly located throughout an installation.
3. All wire and cable utilized in systems interconnection shall be of the flame- retardant type (FR-1 flame test).

G. Penetrations of Cabling in Construction:

1. All cabling or system interconnection which passes through or into acoustically isolated areas, such as sound locks and studios, shall be suitably sealed after cable has been installed.
2. Contractor shall provide all necessary fire stopping of openings through which cable is installed under this Specification in accordance with NFPA 70 and all local Codes. This includes installation in conduits, raceways, or bare penetrations in fire-rated barriers. All Contractor installed "fire stop systems" must be UL approved including fire stop material (Fire Barrier Caulk), which must be UL 1479 approved,

H. Wire Labels:

1. During installation both ends of all wires or cables shall be clearly labeled with approved wire labels.
2. The wire labels shall be numbered consecutively with respect to the patch bay with a leading service level designation. If there are no patch bays utilized in the system the wire labels shall be numbered consecutively with a leading service level designation.
3. The wire labels shall not be more than 8 inches or less than 4 inches from the connector or termination at each end of the cable.
4. Wire labels shall utilize plastic shrink-wrap, protecting the text and ensuring they remain affixed to the wiring. Approved: Thomas and Betts or approved equal, submit sample to the CM's Representative.

I. Documentation:

1. Maintain a careful running log of route and terminations for each cable.
2. A detailed wiring diagram shall be furnished with wire numbers shown as part of the As-Built Documentation. All spare cable shall be shown on the As- Built Documentation.

J. Cable Management:

1. Cables shall be grouped and bundled by type and routed from source to termination in a uniform manner throughout all equipment housings. Care shall be taken not to break the insulation or deform the cable by harness supports. Cables shall not change relative position in a cable group throughout a cable route.
2. Cable support bars shall be installed to support cables in areas of dense harness break-outs such as behind patch panels, distribution amplifiers and other multiple input/output devices.

3. Edge protection material ("cat track") or grommets shall be installed on the edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edges.

K. Terminations:

1. The Contractor shall employ the latest termination practices and materials.
2. Signal and control cable ends shall be neatly formed, and shrinkable tubing shall be applied where necessary to secure the insulation against fraying or raveling.
3. Field terminations shall be made with terminal blocks.
4. Internal rack terminations and field terminations shall be made with terminal blocks.
5. Punch block terminations are not acceptable and shall not be allowed.
6. Coaxial connectors shall be crimp-on and then soldered. Audio and control wires shall be terminated with crimp-on lugs, and then soldered.
7. Digital media cabling — submit proof of applicable cable termination training prior to installation and terminate per Manufacturer's detailed instructions.
8. All bare wire shall be tinned prior to termination unless the Connector Manufacturer recommends otherwise.
9. Unused line level shields shall be individually insulated using shrinkable tubing and attached to the cable using an additional piece of shrinkable tubing.

L. System Grounding:

1. The "spider" concept is designed to avoid ground loops and inductive coupling.
2. The systems shall be hum free, stable and free of oscillation with the earth ground temporarily disconnected.
3. The earth ground shall be made at only one point in the system as indicated and shall be in accordance with National Electric Code 2002 paragraphs 250.146(D), 406.2(D) and 408.20 Exception.
4. The grounding method shall insure that the system is free of the following problems under any mode of operation:
 - a. RF oscillation, pickup and interference.
 - b. Distortion.
 - c. Crosstalk.
 - d. Signal Leakage.
5. Major wiring ducts or trays shall be grounded to the conduit system.
6. The equipment racks shall be isolated from, and not electrically bonded to, the building conduit system. This means that the conduit system shall not be electrically connected to the equipment racks and that the equipment racks shall be installed so that they are electrically isolated from the building structural steel. The racks shall be electrically bonded at only one point to the isolated grounding system as shown on the AV Category Drawings.

10/20/17

M. Seismic Restraints:

1. All hanging or free-standing equipment and cabinets furnished including but not limited to racks, loudspeakers, projection screens, and TV monitors shall be secured to substantial building structures. The equipment described shall resist seismic acceleration

in any direction up to a limit of the greater of 1.0 G or the limit prescribed by the Local Governing Codes.

2. Maintain electrical isolation between the equipment racks and building steel.
3. Loudspeaker hanging details, rack bracing, and other seismic restraints are not shown on the Contract Drawings; it shall be the Contractor responsibility to develop these Drawings.
4. Submit loudspeaker mounting (rigging) Drawings to the Architect for review after they have been stamped and signed by a licensed Structural Engineer engaged in regular practice in the Project's State.

N. Audio System Processing Adjustments:

1. The Contractor shall program the Digital Signal Processing system to include filters adjusted such that the loudspeaker zone(s) effected by same are measured to exhibit uniform (flat) frequency response (less than ± 3 dB) at the listening location for the frequencies the transducer is designed/intended to address. Measurements utilized for determining filter adjustments shall be made on axis with respect to a single transducer (representative of the zone) in its intended field of coverage. Loudspeaker cross-over filters shall be provided first for all actively crossed transducers per Loudspeaker Manufacturer's instructions. Additional filters will still be required to achieve uniform frequency response measured at the various listening locations. For loudspeaker zones of small transducers, utilize high-pass filters first and foremost and then utilize parametric EQ filters to flatten the measured response. For loudspeaker zones of large transducers, where other transducers in the system will address higher frequencies, utilize low-pass filters first and foremost and then utilize parametric EQ filters to flatten the measured response.
2. The Contractor shall program the Digital Signal Processing system to include delay settings adjusted so that the direct sound from the main loudspeaker clusters and the delay zone transducers in question arrives simultaneously at the listening plane served by the delay zone transducers. The AV Consultant may add additional delay to address 'imaging / Haas affect preferences' as appropriate.
3. The AV Consultant may add additional filters and delay (as required) to address 'tuning preferences', but such 'tuning preferences' shall not be considered as part of the Base Line Requirements for determining substantial completion of the audio system. Flat frequency response and time alignment of the direct sound from the loudspeakers will be considered a Base Line Requirement for determining substantial completion of the audio system.

O. Loudspeaker Installation:

1. Verify all loudspeakers aiming and positioning with CM's Representative.
2. Submit Loudspeaker Mounting (Rigging) Drawings to the Architect for review after they have been approved and signed by a certified Structural Engineer engaged in regular practice in the Project's State.

P. Video Projector Installation:

1. The video projector shall be converged, registered and color balanced, Obtain from the CM all scan rates and resolutions that are to be used and properly converge the projector

for all possible inputs. In addition, the Contractor shall optimize the projector for the following standard scan rates and resolutions:

- a. HDTV, 720p, 1080i and 1080p
- b. 1280 x 800, 60Hz, 70Hz, and 75Hz
- c. 1440 x 900, 60Hz, 70Hz and 75Hz.
- d. 1600 x 1200, 60Hz, 70Hz and 75Hz.
- e. 1920 x 1080, 60Hz, 70Hz and 75Hz
- f. 1920 x 1200, 60Hz, 70Hz, and 75Hz

3.04 SYSTEM PERFORMANCE TESTS:

- A. The Contractor shall pre-assemble and test all systems and sub-systems in his own facility before completed assemblies are delivery to the Project Site.
- B. Tests shall include but are not limited to those listed below in order to verify that the system meets all Design Requirements.
- C. The Contractor shall perform the initial system testing and adjustment prior to scheduling the final system acceptance tests.
- D. All tests shall be fully documented and a neat copy presented for review by the CM's Representative and inclusion in the system manual.
 1. Performance Tests on Individual Components:
 2. Perform in Contractor's facility.
 3. Verify that the Manufacturer's Specifications are met.
 4. Measure and record the impedence on each driver, and verify the acoustical output and freedom from rattles and distortion of all loudspeakers.
- E. Performance Tests on Completed Component Sub-assemblies:
 1. Perform in Contractor's facilities.
 2. Before delivery of the equipment to the project site, the specialty Contractor shall demonstrate to CM's Representatives at the Contractor's facilities that all sub-assemblies are operating as specified.
 3. Verify the achievement of the Specifications for each electronic component in situ, i.e., as assembled in its console, rack or other enclosure, powered by the system power supply and with all other components also activated, i.e., powered and interconnected. The magnitude and character of the threshold noise shall be observed for appearance of hum in excess of that present with individual activation, or the appearance of high frequency oscillation.
 4. Projection equipment shall be tested to verify that the Manufacturer's Specifications are met after it has been incorporated into a complete subassembly.
 5. Video equipment shall be tested to verify that its operation meets the Manufacturer's Specifications and EIA RS-170A after assembly into complete subsystems.
- F. Performance Tests on the Complete System:
 1. Verify that all wiring is correctly and completely installed. Verify that there are no short circuits between conductors within any cable, or from cable to cable. Verify the integrity of each conductor, i.e., that the conductor is not open circuited. In addition, the correct

polarity of each connector, including those in patch panels, shall be verified and the color-coding scheme shall be recorded and included in the documentation provided to the CM's Representative.

2. Verify that the entire system performance is in accordance with the Design Requirements. Specific attention is directed to the following for each system:
 - a. Projection Equipment.
 - b. Source Equipment Transports
 - c. Video Matrix Switchers.
 - d. Remote Control Components.
 - e. Video Distribution Amplifiers.
 - f. Audio Amplifiers.
 - g. Consoles.
 - h. Networking Equipment.
- G. The threshold noise output of the system, measured at the output of the power amplifier, must equal the input when its gain control is full on, and of the line or booster amplifier input when all channel controls are off. No hum shall be audible in the system within the noise signal, or with the inputs terminated in microphone impedance and all controls full on. No high frequency oscillation shall be observed at the system output. No audible radio signal shall be detectable in the system at any control setting. Depending upon the proximity of a local radio station or upon the cable configuration of the system, RF oscillation or leakage may be a problem and the Contractor shall be prepared to install a RF low pass filter appropriately in the system as a final remedy.
- H. Cross talk between channels shall be measured with signal equivalent to 1.0 Volts output into one channel with its gain off and the gain of each other channel varied over their full range. Maximum signal leakage at the system output must be equivalent to -70 dB re 1.0 Volt at the pre-amp output at 1 kHz, increasing to -52 dB at 8 kHz.
- I. The general performance of each loudspeaker unit in situ shall be verified by applying pink noise signal at 10.0 Volt level and verifying the specified output SPL at a distance of 1 foot. Normal undistorted sound quality shall be verified by headphone listening at the output of the calibrated system. Each loudspeaker shall also be fed with an oscillator signal at 10.0 Volt level within its intended frequency range, verifying absence or abnormal distortion of rattles due to installation.
- J. The audio system shall be adjusted as specified above in paragraph entitled "Audio System Processing Adjustments" where Minimum Requirements for establishing readiness for the substantial completion observation of an audio system are specified.
- K. The complete video system shall be tested in the following manner: All video outputs of the system shall conform to EIA RS-170A when typical inputs to the system are fed with a "known good signal" from a video signal generator.
- L. Provide installation functionality test results report prior to substantial completion punch walk.
- M. Test procedures for video systems shall conform to the following Basic Guidelines:
 1. All equipment and video signal chains shall operate according to Manufacturer's Specifications and/or to the EIA RS-170A Standard.
 - a. Black level (using the brightness control).

- b. White level (using the contrast control).
 - c. Correct Hue.
- 2. All video cameras shall be setup and adjusted for the following:
 - a. Black balance.
 - b. White balance.
 - c. Range of zoom and iris function.
- N. All these tests, and any others that the Contractor may wish for his own satisfaction, shall have been performed and successfully achieved before observation requested. The CM's Representative may request repetition and demonstration during observation of certain of these tests or other critical tests if problems become apparent. If Specifications are not met, further observations will be at the Contractor's expense.

3.05 DEMONSTRATION AND ACCEPTANCE TESTING

A. Substantial Completion Observation:

- 1. The Contractor shall file a written notice with the CM when all of the aids to use describe in "Submittals", above, have been submitted for approval, all tests described in above in "System Performance Tests", are complete and the test reports have been submitted for review and approval and the systems and sub-systems are ready for the Substantial Completion Observation.
- 2. The Contractor shall be prepared to demonstrate the overall system performance including but not limited to functionality, control system programming, operation, optics performance and Digital Signal Processing software control (where applicable). The Contractor shall be prepared to demonstrate proper gain structure and that base line EQ (equalization of uniform frequency response) settings and delay filters (time alignment) have been set. In addition, the Substantial Completion Observation of the systems may include repetition or demonstration of any or all of the tests described in "System Performance Tests" above or other critical tests if problems become apparent and the Specifications are not met. After the Substantial Completion Observation, written notice noting whether the systems meet the criteria set forth in the General Conditions for Substantial Completion, along with a list of items for the Contractor to correct shall be provided to the Contractor.
- 3. In the event that the systems are found not to be Substantially Complete, all of the costs including fees, travel and living expenses in connection with subsequent observations or corrective work shall be borne solely by the Contractor. This includes new problems that arise during the course of the subsequent observations.

B. Acceptance Observation:

- 1. After the systems have been certified as Substantially Complete, and the Contractor has filed written notice with the CM that the corrections ordered, have been completed, a Final Acceptance Observation shall be scheduled.
- 2. During the Final Acceptance Observation of the systems repetition or demonstration of any of the tests described in "System Performance Tests", above, or other critical tests if problems become apparent and the Specifications are not met, may be requested.

3. Assist in performing final system adjustments and acceptance tests. Provide all labor, materials and tools necessary for these tests and adjustments. Provide all necessary test equipment to complete the tests.
4. Budget 24 working hours for the performance of these tests and adjustments with the CM's Representative. If final acceptance is delayed beyond this period because the installation is not in proper working order or is incomplete, the Contractor shall pay for all additional time and expenses for any resultant extension or re-scheduling of the acceptance testing period.
5. Any measurements of frequency response, distortion, noise or other characteristics and any adjustments deemed necessary may be performed on any item or group of items, including re-orientation of loudspeakers, to insure optimum performance of the system.
6. In the event that the corrections have not been completed to the satisfaction of the CM's Representative, or new problems arise at the time of the Acceptance Observation, all costs including consulting fees, travel and living expenses in connection with subsequent observations or corrective work shall be borne solely by the Contractor.

C. Acceptance:

1. After observations and tests indicate that the entire AV system and sub systems as specified herein and indicated on the Drawings are in total compliance with the Drawings and Specifications, a letter indicating said compliance shall be issued.
2. Acceptance of the system shall be accomplished as described in the General Conditions.
3. Final acceptance of the installation will be granted when it is clear to the CM's Representative and the architect that the following conditions have been met:
 - a. All fixed equipment has been furnished and installed according to the Drawings and Specifications.
 - b. All portable equipment has been turned over to the CM.
 - c. All equipment and installation have been tested and shown to perform as specified.
 - d. All Instruction Manuals, Software Source Code and As-Built Documentation have been completed and delivered to the CM's Representative.
4. The Warranty period will begin only when all of the above listed items have been performed to the satisfaction of the Architect, CM and CM's Representative.

D. TRAINING

1. Submit all training materials to the CM's Representative for approval prior to scheduling training sessions.
2. Provide 24 hours of hands on training practical operation of the system to the CM's Representative. Address in the training, the general configuration of the system, basic functionality, correct operation procedures, routine maintenance and upkeep.
3. Provide 4 hours of follow-up training within 3 months of the initial training to review aspects of the original training and provide instruction on specific troubleshooting issues the CM's Representative raises during the training,
4. Record via video and audio all training sessions and provide 3 copies to the CM on DVD-R format.

END OF SECTION 27 41 16
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SECTION 27 51 26
ASSISTIVE LISTENING SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

Submit block wiring diagrams and catalog data showing component interconnection and descriptive literature for all component parts and cabinets.

1.03 EQUIPMENT QUALIFICATION

- A. All Equipment shall conform to Federal, State and Local applicable Codes, Ordinances and AHJ, and shall be listed and labeled by Underwriters Laboratories.
- B. Assistive-Listening Systems
1. Assistive-listening systems shall be provided in accordance with CBC Section 11B-219 and shall comply with CBC Section 11B-706.
 2. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two. 25% minimum of the receivers provided, but no less than two shall be hearing-aid compatible in accordance with CBC Section 11B-706.3.
 3. If the system provided is limited to specific areas or seats, then such areas or seats shall be within a 50-foot viewing distance of, and have a complete view of, the stage or playing area. CBC Section 11B-219.4.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The Assistive Listening System shall include the following items
1. Instructor (program source) wireless transmitter units.
 2. Student (audience) portable wireless receiver units.
 3. Plug-in microphones and earphones, for each unit.
 4. Multiple program source inputs for, Instructor's microphone, respective room audio/video A/V system input/output and Instructor's computer audio input/output.

5. System accessories.

B. Function

1. The Assistive Listening System shall provide amplified available audio programs for hearing impaired students/audience, originating from classroom/stage/room instructors and audio/video instructional program source materials, and equipment in respective building spaces, rooms, classrooms and outdoor areas.
2. The audible program shall be transmitted wireless from the program source to the student/audience, with reception coverage throughout not less than approximately 80% of the respective floor space/area space.
3. Shall provide automatic stereo or mono audio full system operation, depending on program source input.
4. The system in each space shall comply with Federal ADA, State and Local AHJ Requirements for the hearing impaired.

2.02 MATERIALS (RF WIRELESS)

A. General

1. Power for each portable unit operation shall be supplied by internal, changeable rechargeable NiCad batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer/two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 10-hours with NiCad (NiMH) batteries. The batteries shall be rechargeable without removal from unit.
2. Provide power on-off control on each unit, to extend battery duration.
3. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.
4. The receivers and transmitters shall be US Government FCC and Industry Canada-approved, for FM-RF (radio frequency) wireless operation.
5. All components shall be the product of the same Manufacturer.
6. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Instructors Portable (Program Source) RF Transmitter Units

1. The transmitter, shall be compact, easily portable units, self-contained ABS, plastic housing/enclosure shall clip to a pocket or belt.
2. Each portable transmitter shall provide RF transmitting on one of the US Government 40 different FCC – and Industry Canada-approved narrow-band channels in the 72-86MHz RF band.
 - a. Line-of-sight transmit-distance range of not less than 100-feet up to 150-feet from transmitter to receiver.
3. Easy-to-read channel label and volume adjustment on the front unit face. Stereo and mono audio processing.

4. 3.5mm auxiliary input jack that allows transmission of audio from an auxiliary source such as a cassette recorder, computer, CD/DVD player or television audio source. The transmitter shall also provide a second 3.5mm microphone input source jack. The two input sources shall be simultaneously operational to provide a mixed signal output RF transmission of the two sources.
5. Select the separate independent RF transmission frequency for each transmitter to prevent transmission interference between units and to provide for at least two student receiver units to selectively overlap reception of the transmitter.
6. Quantity of Instructor's portable RF transmitters
 - a. Provide quantity of nine instructor portable transmitters, 3-on low band; 3-on mid band and 3-on high band RF frequencies.
 - b. Provide a quantity of one portable transmitter at the respective room audio/video (A/V) equipment, program output source. Provide 120 volt AC-to-DC power-supply for portable transmitter at the A/V equipment location.
7. Extended range fixed base non-portable RF transmitter.
 - a. Provide fixed location non-portable base unit RF transmitter for spaces larger than 9,000 square foot indoor or outdoor spaces.
 - b. Shall have the same RF characteristics and performance as the portable transmitter except as follows:
 - 1) Line-of-sight transmit-distance range of not less than 800-feet from transmitter to receiver.
 - 2) Fixed install location non-portable, with NEMA-1 metal housing.
 - 3) Radiated RF energy intensity shall provide manual attenuation adjustments to prevent multiple adjacency RF interferences.
 - c. Provide a student/audience portable RF receiver unit at the RF base unit to receive RF signals from an instructors RF transmitter. Connect to the base unit to rebroadcast. Provide a self-contained 120-volt AC-to-DC power-supply for the portable receiver at the base unit transmitter.
 - d. Shall operate on 120 volt 60Hz AC branch circuit. Provide remote system master on-off control.
 - e. Provide remote RF antenna (outdoor/indoor) rated, for fixed base RF transmitter. Antenna shall extend the transmitter range for large spaces. Provide two RG-6 coaxial cable connects from antenna to base transmitter.

C. Student/Audience Receiver Units

1. The multi-channel narrow-band FM receivers shall be compact easily portable units, self-contained ABS/plastic housing/enclosure and shall clip to a pocket or belt.
2. The receiver shall provide an on/off switch and volume control which adjusts the output level as required by the listener.
3. The receiver shall have a 3.5mm output jack which accepts one of any of the plug-in listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.
4. The receiver shall have an easy-to-read channel label on the front face. The receiver shall incorporate an automatic squelch circuit which eliminates white noise when the receiver is out of transmission range. Stereo and mono audio reception and processing.

5. The multi-channel receiver shall receive any six of the US Government forty different FCC- approved narrow-band FM frequencies within the 72-76MHz band from the respective transmitter units. The user shall be able to change to any one of these six frequencies by using a slide or rotary switch on the receiver. Label on the front face shall indicate the receiver is a multi-channel unit. A label inside the battery compartment shall indicate the six channels that are available to the user.
 6. Quantity of portable RF receivers
 - a. Provide a quantity of two receivers with matching frequencies for each transmitter, not less than eighteen total quantities of receivers.
 - b. Provide a quantity of one receiver with matching RF frequency of the transmitter at the respective room audio/video (A/V) equipment, program input source. Provide 120 volt AC-to-DC power-supply for portable receiver at the A/V equipment location.
 - c. Provide hearing aid compatible units at a ratio of one per four receivers in accordance with ADA 219.3.
- D. RF System Accessories
1. Battery recharger portable charger/organizer pack.
Locking, portable case with cover, shall accept a group of not less than twelve plug-in portable transmitter and receiver units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one organizer for each quantity group of twelve (or fraction thereof) transmitters receivers provided as part of the Contract.
 2. Stereo audio headset style automatic noise canceling microphone, integral on-off-volume control and with behind the neck support style each with cable and outlet plug-jacks to match transmitter jacks. Provide two cables for each transmitter.
 3. Equipment wall mount support brackets.
 4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two for each transmitter.
 5. Stereo audio headset style ear phones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one headset for each receiver.
 6. Rechargeable Ni-Cad (NiMH) batteries, one complete set for each transmitter and receiver unit.
 7. Locking auxiliary equipment storage cases for cables, microphones and headsets, with quantity and capacity for all auxiliary accessories furnished as part of the Contract.

2.03 MATERIAL (INFRARED WIRELESS)

- A. General
1. All equipment shall be the product of the same Manufacturer.
 2. The receivers and transmitters shall be US Government FCC and Industry Canada-approved.
 3. Provide power on-off control on each unit, to extend battery duration.
 4. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Master (Program Source) Transmitter (Infrared Emitter) Units

1. The infrared emitter/transmitter shall be compact, portable units, self-contained ABS/plastic housing/enclosure.
2. The emitter panel shall be a dual-channel system operating on both 2.3 and 2.8MHz invisible infrared light waves' frequencies. The channels shall be designated "CHANNEL A" for the left and "CHANNEL B" for the right.
3. The emitter shall provide left and right AUDIO IN jacks to accept an input signal from a sound system, left and right "SYNC IN/SYNC OUT" jacks for master/slave daisy-chaining with other emitters if desired, and left and right "MIC-IN" jacks to accept an audio signal from a microphone or Audio/Video preamplifier.
4. The emitter shall provide separate LED input level detectors for each channel which illuminate when the audio signal peaks. Stereo and mono audio processing.
5. The emitter shall be mounted by the following methods:
 - a. Fixed to a wall with an adjustable, wall-mounting support bracket accessory.
 - b. Portable mounted to a table-top-or floor-stand, using accessory support-stand adapter.
6. Each emitter shall provide an array of not less than 130-infrared LEDs covered by an infrared transparent acrylic lens. The infrared signal from each emitter shall cover not less than 3,000 square feet (32,000 cubic feet) enclosed space. Note: For room sizes smaller than 3000 square feet, the infrared transmitter/emitter infrared output shall be reduced to accommodate the actual smaller room square feet size and height.
7. 120 volt 60Hz AC input to nominal 24-volt DC output (plug-in "power-brick") power supply external transformer shall be UL approved, with cable "plug-in" connection to emitter/transmitter. Provide remote system master on-off control.
8. Slave emitter/transmitter for rooms exceeding 30,000 cubic feet. Provide one additional infrared emitter/transmitter repeater slave unit, for each additional 30,000 cubic feet room volume, or fraction thereof. The slave repeater shall receive and retransmit the program signals from the master unit. Provide one 100-foot long "master-to-slave" auxiliary portable extension wire cable for each slave unit.
9. Provide wall mount plug-in outlets for instructors' microphone outlet connect ports to emitter/transmitter.
 - a. Provide 1.0-inch conduit and wire, homerun connect from microphone outlet to each room respective emitter/transmitter and slaves. Provide conductors as recommended by Manufacturer.
 - b. Provide 1.0-inch conduit and wire homerun connect from microphone outlet to respective room Audio/Video (A/V) equipment, microphone program source input. Provide conductors as recommended by Manufacturer.
10. Provide a quantity of nine emitter/transmitter "master" units, plus additional "slave" units for adjusted room sizes.

C. Student/Audience Receiver Units

1. Battery Power
 - a. Power for each unit operation shall be supplied by internal, changeable rechargeable NiCad batteries and alternately by alkaline disposable batteries. Rechargeable

batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer / two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 15-hours with NiCad (NiMH) batteries.

- b. Provide power on-off control on each unit, to extend battery duration.
 - c. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.
2. The receiver shall be a dual-channel unit for wearing around the neck with an adjustable strap. Stereo and mono audio reception and processing.
 3. Compatible with the transmitter (emitter) and operate on 2.3MHz and 2.8MHz frequencies invisible infrared light waves. Self-contained and switchable from “CHANNEL A” to “CHANNEL B” through a switch located on the back of the unit.
 4. The receiver shall provide an infrared light-gathering lens on the front of the unit to focus the light signal from the emitter onto the infrared detector element. The receiver shall detect and decode the infrared emitter/transmitter light source within a 160° acceptance angle.
 5. Audio squelch circuit which turns the output circuit off when the infrared signal is reduced or not received, with on/off and volume control.
 6. Output jack, which accepts any of the listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.
 7. Shall be compact easily portable units, self-contained ABS/plastic housing/ enclosure with red infrared receiver lens. Shall clip to pocket or belt.
 8. Provide quantity of two infrared receivers for each master transmitter, not less than eighteen total quantities of receivers.
- D. Infrared System Accessories
1. Battery recharger portable charger/organizer pack.
Locking, portable case with cover, shall accept a group of not less than twelve plug-in portable transmitters and receivers units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one organizer for each quantity group of twelve (or fraction thereof) receivers provided as part of the contract.
 2. Stereo audio headset style automatic noise canceling microphones, integral on-off-volume control and with behind the neck support style. Each with 25-foot long extension cables and outlet plug-jacks to match transmitter outlet jacks. Provide two cables for each emitter/transmitter.
 3. Equipment wall mount support brackets.
 4. Auxiliary audio program source 15-foot long cables with plug-in at both ends to match transmitter jacks. Provide two for each transmitter.
 5. Headset style ear phones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one headset for each receiver.
 6. Rechargeable Ni-Cad (NiMH) batteries, one complete set for each unit.

7. Locking auxiliary equipment storage cases for cables, microphones and headsets. Quantity and capacity as required to store all accessories.
8. Portable floor stand, for infrared emitter/transmitter units mounting and support, with variable height adjustment and tip-resistant weighted base. Provide one floor stand for each infrared emitter/transmitter.
9. Locking, portable case for infrared emitter/transmitter. One for each emitter/transmitter unit.
10. Provide microphone extension cable with plug to match microphone and infrared emitter/transmitter microphone input jack, 25-foot length. One for each microphone.

PART 3 - EXECUTION

3.01 GENERAL

A. Each System General

1. Assemble, set up, and test each transmitter, receiver, and accessories units.
2. Install and fully charge all batteries prior to and after testing/set-up is complete.

B. Wireless RF Units

1. Perform an onsite RF frequency survey to determine available unused RF channels, prior to selecting unit operating channels and prior to ordering the equipment.
2. Select operational RF frequency to prevent system RF interference's with other equipment.
3. Provide - one 0.75-inch conduit with two Category-6A, ANSI/EIA/TIA-568C 4-pair, UTP cables connecting from each emitter/transmitter master outlet box location to respective room instructors microphone outlet box location. Provide matching RJ-45 Category-6A female jacks at each outlet box for each cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to-portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

C. Wireless Infrared Units

1. Provide aiming and intensity adjustments of emitter/transmitter units to insure complete room coverage.
2. Provide - one 0.75-inch conduit with two Category-6A, ANSI/EIA/TIA-568C 4-pair, UTP cables connecting from each emitter/transmitter master outlet box location to respective room instructors microphone outlet box location. Provide matching RJ-45 Category-6A female jacks at each outlet box for each cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to-portable cable plug-in transition and circuit impedance matching audio/transformer into respective equipment. Additionally provide four portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.
3. Provide - one 0.75-inch conduit with two Category-6A, ANSI/EIA/TIA – 568C, 4-pair UTP cables connecting from each emitter/transmitter master outlet box location to respective room audio amplifier / preamplifier location. Provide matching RJ-45

Category-6A female jacks at each outlet box location for each UTP cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to-portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

END OF SECTION 27 51 26
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SECTION 27 53 13
CLOCK SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 - 2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit product data sheets and descriptive literature for all component parts.
- B. Submit block wiring diagram of the clock and paging systems, showing headend equipment, terminal cabinets, remote power supplies, and typical clock for each zone.

1.03 EQUIPMENT QUALIFICATION

- A. The Specification is based on the equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the Requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer's data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.
- B. All equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

1.04 QUALIFICATIONS

To qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be qualified Sound Contractor and shall hold a valid C61 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction (AHJ) over the work. The Contractor shall be the Factory Authorized Distributor for the brand of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

1.05 GENERAL REQUIREMENTS AND SCOPE

- A. Furnish and Install a complete new GPS wireless clock system using Primex Wireless Inc. GPS wireless system or equal by American Time and Signal, Sapling. All bids shall be based on the equipment as specified herein.

- B. Section includes Transmission Systems GPS Receiver, Primary Transmitter, and Satellite Transmitter.
 - 1. Clocks:
 - a. Analog
 - b. Digital

1.06 RELATED SECTIONS

Division 26 – Electrical (120 volt grounded outlet required for transmitter).

1.07 REFERENCES

This Technical Specification and Associated Drawings, Primex Wireless GPS Satellite Time System User Manual.

1.08 DEFINITIONS

GPS: Global Positioning System, a worldwide system that employs 24-satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world’s most accurate and reliable time.

1.09 SYSTEM DESCRIPTION

- A. GPS wireless clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.
- B. The system shall provide wireless time using GPS and be synchronized to UTC. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Saving Time
- C. Analog Clocks shall be synchronized to within 10-milliseconds 6-times per day, and the system shall have an internal oscillator that maintains plus or minus 1-second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- D. The system shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.
- E. The system shall incorporate a “fail-safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.
- F. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.
- G. The system must operate in accordance with a “Radio Station Authorization”, Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.10 REGULATORY REQUIREMENTS

- A. Equipment and components furnished shall be of Manufacturer’s latest model.
- B. The end user will hold a License, known as a “Radio Station Authorization” granted by the FCC.
 - 1. This License grants the end user protected use for wireless transmission at the designated frequency.
 - 2. This License will designate a unique “call sign” for each end user.

- C. Transmitter and Receiver shall comply with Part 90 of FCC rules as follows:
 - 1. This device may not cause harmful interference, and
 - 2. This device must accept interference received, including interference that may cause undesired operation.
 - 3. Transmitter frequency shall be Governed by FCC Part 90.35.
 - 4. Transmitter output power shall be Governed by FCC Part 90 257 (b)
- D. System shall be installed in compliance with Local and State Authorities Having Jurisdiction.
- E. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the District/End User prior to operating the equipment. The original license must be delivered to the District/End User.
- F. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.
- G. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.
- H. Floor Plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to District prior to installation.

1.11 QUALITY ASSURANCE

- A. Permits: Obtain Operating License for the transmitter from the FCC.
 - 1. Qualifications:
 - a. Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 4 years' experience producing GPS wireless time systems.
 - b. Installer: Company with documented experience in the installation of commercial time systems.
 - 2. Prior to installation, a site survey must be performed to determine proper transmitter placement.

1.12 DELIVERY STORAGE AND HANDLING

- A. Deliver all components to the site in the Manufacturer's original packaging. Packaging shall contain Manufacturer's name and address, product identification number, and other related information.
- B. Store equipment in finished building, unopened containers until ready for installation.

1.13 PROJECT SITE CONDITIONS

- A. Clocks shall not be installed until painting and other finish work in each room is complete.
- B. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.14 SYSTEM STARTUP

At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

1.15 WARRANTY

Manufacturer will provide a 1-year warranty on GPS receiver, transmitter, and satellite transmitter. All other components will have a 1-year warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURER

GPS wireless clock system shall be manufactured by Primex Wireless, Inc., N3211 County Road H, Lake Geneva WI 53147, telephone (800) 537-0464, Fax (262) 248-0061, www.primexwireless.com or equal by American Time and Signal, Sapling.

2.02 SEQUENCE OF OPERATION

- A. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.
- B. Analog Clock Operation:
 - 1. Apply power or insert batteries. Follow set up procedures detailed in Manufacturer's instructions.
 - 2. After initial setup, the clock will shut off the receiver. Six times each day, the micro-processor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.
 - 3. If the clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.

2.03 EQUIPMENT

- A. General: The clock system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.
- B. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.
- C. The GPS Receiver cable must be plenum rated where required by local Code.
- D. Transmitter: Primex Wireless Model 14400, consisting of wireless transmitter with GPS receiver, a surge suppressor/battery backup, and a mounting shelf. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.
 - 1. Transmission:
 - a. Frequency Range: 72.100 to 72.400 MHz.
 - b. Transmission Power: 1 watt (30dBm) maximum
 - c. Radio technology: narrow band FM

- d. Number of channels: 16
 - e. Channel bandwidth: 20kHz maximum
 - f. Transition mode: one-way communication
 - g. Data rate: 2 Kbps
 - h. Operating range: 32 degree F to 158 degrees F (0 degrees C. to 70 degrees C).
2. Transmitter:
 - a. Transmitter output power: +26 to +30 dBm
 - b. Frequency deviation: +/- 4 kHz
 - c. Transmitter Power Requirements: 120 VAC 60 Hz
 - d. Internal Power Requirements: 5 VDC
 - e. Carrier frequency stability: +/- 20 ppm
 3. Transmitter shall have 16 selectable channels to assure interference-free reception.
 4. Transmitter shall have the following switches:
 - a. Time zone adjustment switches for all time zones in the World. Includes Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
 - b. Daylight Saving Time bypass switch.
 - c. 12-hours or 24-hours display.
 5. Transmitter housing shall be black metal case, 16¼-inches (424.4mm) by 12 inches (304.8mm) by 1-7/8 inches (46.4mm) in size.
 6. Antenna shall be 46-inches (1168mm) high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.
 7. Transmitter housing shall incorporate a display which shall include the following:
 - a. Time readout
 - b. AM and PM indicator if 12-hour time display is set
 - c. Day and date readout
 - d. Indicator for daylight savings or standard time
 - e. LED which shall flash red in event of reception problem
 - f. GPS reception indicator
 8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
 9. Power supply (included):
 - a. Input: 120 volt AC 50/60 Hz, 0.4 amps.
 - b. Output: 9 volt DC, 1.5 amps.
- E. Surge Protector/Battery Backup (included).
1. Input: 120 volt AC 60 Hz +/- 1 Hz.
 2. Output: 120 volt AC, 500VA, 300 watts
 3. Surge Energy Rating: 365 joules

F. Additional Equipment

1. Wireless Receiver Switches: Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:
 - a. Antenna mounted on top of the switch housing, 11½-inches (292mm) long. Power Supply:
 - 1) Input 120 VAC 50/60Hz, 0.4 amps
 - 2) Output: 9 volt DC, 1.5 amps RS 232 data cable, 5 feet (1.5mm) long
 - b. Daylight Savings Time bypass switch
 - c. Dimensions: 4¼-inches (108mm) long, 5¾-inches (146mm) wide, 1¼-inches (31.75mm) deep.
 - d. Weight: 12 ounces (.34kg)
 - e. Operating Range: 32 degrees F to 158 degrees F (0 to 70 degrees C)
2. Satellite Transmitters Primex Wireless Model 14401: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter. The unit shall include the following:
 - a. Antenna mounted on top of the housing, 46 inches (1168mm) long.
 - b. Wireless Receiver Switch.
 - c. Power Supply Input: 120
 - d. VAC, 50/60Hz, 0.4-amps
 - e. Output: 9 volt DC, 1.5-amps.
 - f. 6 foot (1.83m) cord
 - g. Surge Suppressor/Battery Backup
 - h. Mounting Shelf.
 - i. Transmission Power: 1 watt maximum
 - j. 72 MHz frequency.
3. Traditional analog clocks (battery): Analog clocks shall be wall mounted. Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black.
 - a. 9 inches (228.6mm) diameter analog clock: Primex Wireless Model 14280
 - b. 12½-inch (317.5mm) diameter analog clock: Primex Wireless Model 14155
 - c. 16 inches (406.4mm) diameter analog clock: Primex Wireless Model 14163
 - d. 24 inches (610mm) diameter analog clock: Primex Wireless Model 14346
4. Additional colors, finishes, and dial faces are available from Manufacturer.
 - a. Analog clocks shall be battery-operated,
 - b. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired.
 - c. Time shall be automatically updated from the transmitter 6 times per day.
 - d. Analog clocks shall remember the time during changing of batteries.
 - e. 9 inches (228.6mm) and 12.5 inches (317.5mm) analog clocks shall have a tamper proof/ theft resistant clock lock mounting slots.

5. Analog clock receivers shall be as follows:
 - a. Receiver sensitivity: >-110 dBm
 - b. Receiver power: 24 VAC or 120 VAC (see model #)
 - c. Antenna type: internal
 - d. Antenna gain: -7 dBd

If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second-hand will "five-step" as a visual indicator that the signal has been lost. Should the clocks lose power and signal, the clocks will not function.

6. Wire guards: Provide one for each analog clock as follows:
 - a. Analog clock wire guard Primex Wireless Model 14131, 14-inches by 14-inches (355.6 by 355.6 mm) size, for nominal 12½-inch (317.5 mm) diameter analog clocks.
 - b. Analog clock wire guard Primex Wireless Model 14123, 18-inches by 18-inches (457.2 by 457.2mm) size, for 16 inches (406.4mm) diameter analog clocks.
7. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- B. Verify that 120-volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.

3.02 INSTALLATION

- A. Provide all equipment necessary for a complete and operable system.
- B. Transmitter: Locate transmitter where indicated, a minimum of 2 to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. Transmitter(s) will be placed at locations indicated below:
 1. Attach receiver to transmitter using cable.
 2. Connect antenna to transmitter, using care not to strip threads.
 3. Connect power supply to the transmitter. Set the channel number on the display to correspond to the FCC license.
 4. Plug power supply into electrical outlet.
- C. Analog clocks shall perform the following operations with each clock:
 1. Set clock to correct time in accordance with Manufacturer's instructions.
 2. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.

3. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12½-inch (317.5mm) clock, attach using clock-lock hanging method and suitable fasteners as approved by Clock Manufacturer.
4. Wire guards: Secure to wall, using approved theft-resistant fasteners.

3.03 ADJUSTING

Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.04 CLEANING

Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by Clock Manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.05 DEMONSTRATION

Provide training to District's Representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.06 PROTECTION

Protect finished installation until final acceptance of the Project.

3.07 TESTING

All devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION 27 53 13
022619/212220-SSB

SECTION 28 10 00
ACCESS CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes access control door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Section includes, but is not necessarily limited to, the following for the integrated access control security and site management system:
 - 1. IP-enabled integrated access control door hardware.
 - 2. Monitoring and signaling equipment.
 - 3. System network control processors.
 - 4. Reader controller interfaces and modules.
 - 5. Input monitor and output control interfaces and modules.
 - 6. Remote card readers and display terminals.
 - 7. Power sourcing equipment, network switches and wireless access points.
 - 8. Access control cards and credentials.
 - 9. Access control system application software.
 - 10. Access control system power supplies, back-ups and surge protection.
- C. Related Sections:
 - 1. Section 08 06 71 - Door Hardware Schedule.
 - 2. Section 08 11 13 - Hollow Metal Doors and Frames.
 - 3. Section 08 71 00 - Door Hardware.
 - 4. Division 26 - Electrical: Connections to electrical power system and for low-voltage wiring work.
 - 5. Division 27 - Communications: Connections to the LAN.
 - 6. Section 28 46 20 - Fire Alarm: Connections to building fire alarm system.

1.02 REFERENCE STANDARDS

- A. BHMA A156.13 - American National Standard for Mortise Locks and Latches Series 1000.
- B. BHMA A156.18 - American National Standard for Materials and Finishes.
- C. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
- D. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; also in WDHS-1/WDHS-5 Series.
- E. IEEE 802.3 - IEEE Standard for Ethernet; with Amendments.

- F. NFPA 101 - Life Safety Code.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- H. TIA/EIA-568 - Commercial Building Telecommunications Cabling Standard; Rev C and latest addenda.
- I. Codes and References: Comply with the current version adopted by the Authority Having Jurisdiction.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. System Operational Descriptions: Complete system operational narratives for the integrated access controlled openings defining the Owner's Prescribed Requirements for the opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.
- C. Shop Drawings: Details of electrified integrated locking hardware and access control firmware, indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication and control of the access control system electrified hardware and firmware. Differentiate between Manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - 2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Proof of Certification: Provide copy of Manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized Provider of the primary access control components.
- E. Keying Schedule: Reference Division 08 Section "Door Hardware".
- F. Product Test Reports: Indicating compliance with Cycle Testing Requirements, based on evaluation of comprehensive tests performed by Manufacturer and witnessed by a qualified Independent Testing Agency.
- G. Operating and Maintenance Manuals: Provide Manufacturers operating and maintenance manuals for each item comprising the complete access control and site management installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and telephone number of the Supplier/Integrator providing the installation and the nearest Service Representatives for each item of equipment included in the system. The final copies delivered after completion of the installation test to include "As Built" modifications made during installation, checkout, and acceptance.

1. Record Drawings: During system installation, the Contractor to maintain a separate hard copy set of Drawings, Elevation Diagrams and Wiring Diagrams of the access control system to be used for Record Drawings. This set to be kept up to date by the Contractor with all changes and additions to the access control system accurately recorded.
- H. Warranties and Maintenance: Special Warranties and Maintenance Agreements specified in this Section.

1.04 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage Qualified Manufacturers with a minimum of 5-years of documented experience in providing access control and security systems equipment and software similar to that indicated for this Project and that have a proven record of successful in-service performance.
1. Software and access control systems components to have been previously and thoroughly tested together with proven installations similar in size and functionality to the Design Requirements indicated for this Project.
- B. Integrator Qualifications: Systems Integrators, verifiably factory trained and certified by the Primary Product Manufacturers, with a minimum 3 years documented experience installing complete integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance. Qualifications include, but are not necessarily limited, to the following:
1. References: Provide a list of references for similar projects including contact name, phone number, name and type of Project.
 2. Professional Staffing: Firms to have a dedicated access control systems integration department with full time, experienced professionals on staff experienced in providing on site consulting services for both electrified door hardware and integrated access control systems installations.
 3. Factory Training: Installation and Service Technicians are to be competent factory trained and certified Personnel capable of maintaining the system.
 4. Service Center: Firms to have a service center capable of providing training, in-stock parts, and emergency maintenance and repairs at the Project site with 24-hour/7-days a week maximum response time.
- C. Supplier/Dealer Qualifications: Supplier/Dealers verifiably authorized and in good standing with the Primary Product Manufacturers, with a minimum 3 years' experience supplying integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance.
- D. Integrated Wiegand Output, Wireless, and IP-Enabled access control products are required to be supplied and installed only through designated ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) accounts.

- E. Source Limitations: Obtain the access control door hardware, system firmware and application software specified in this Section from a single source, qualified Supplier/Integrator unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a Source Manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide integrated access control door hardware from the same Manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Regulatory Requirements: Regulatory Requirements and Guidelines as directed in the Building Code including, but not limited to, the following:
 - 1. Comply with California Electrical Code, including electrical components, devices and accessories listed and labeled as defined in Article 100 by a Testing Agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with Accessibility Requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," CBC Chapter 11B as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum Opening-Force Requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Comply with NFPA 101 for doors in a means of egress.
 - 4. Comply with NFPA 80 for fire labeled opening assemblies.
 - 5. The installed access control system shall conform to all Local Jurisdiction Requirements.
- G. Keying Conference: Reference Section 08 71 00 - Door Hardware.
- H. Pre-Submittal Conference: Conduct Coordination Conference in compliance with attendance by Representatives of Supplier(s), Installer(s), Systems Integrator(s), and Contractor(s) to review proper methods and procedures for receiving, handling, and installing door and access control hardware to Manufacturer's recommendations and according to Specifications.
 - 1. Prior to installation of door hardware, arrange for Manufacturers' Representatives to hold a Project specific training meeting on the proper installation and adjustment of their respective products. Product training to be attended by the Installers of access control hardware for the aluminum, hollow metal and wood door sections. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required Inspecting, Testing, Commissioning, and Demonstration Procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
 - 1. Access control firmware and software: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original Manufacturer's sealed containers.
- B. Tag each item or package separately with identification related to the final Access Control Door Schedule, and include basic installation instructions with each item or package.
- C. Deliver permanent keys, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner established at the "Pre-Submittal Conference".

1.06 COORDINATION

- A. Coordinate quantity and arrangement of assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.
- B. Integrated Access Control Door Hardware and Electrical Coordination: Coordinate the layout and installation of scheduled integrated access control door hardware, and related access control equipment, with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.
 - 1. Door Hardware Interface: The access control system to interface and be connected to electrified and integrated access control door hardware as described under Division 08 Sections "Door Hardware" or "Access Control Door Hardware". Coordinate the installation and configuration of electrified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.
- C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing electrified door hardware and access control system components. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing access control system hardware to comply with Indicated Requirements.
- D. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.07 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article will not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under Requirements of the Contract Documents.

- B. Warranty Period: Written warranty, executed by Manufacturer(s), agreeing to repair or replace components of the installed access control system hardware and software that fails in materials or workmanship, including all related parts and labor, within specified Warranty period after final testing and acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - Two years for Integrated Access Control Door Hardware.

1.08 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of standard and access control door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provides continuous 6-months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.
- C. Maintenance Support and Extended Service Agreement: Submit for Owner's consideration an optional extended Service Agreement for the installed access control system, including support for software related issues. The extended Service Agreement is considered elective and is without Manufacturer's Requirement stipulating mandatory coverage for owner and/or vendor system support.
 - 1. A published copy of this Agreement to be included with the submittal package
 - 2. Support for the installed access control system components is provided through the Vendor under a 24 hour Technical Assistance Program.
 - 3. Access control and management system components are to be available on a 1-day turn-around time frame from the Manufacturer.
 - 4. Primary Systems Manufacturer to offer and provide remote modem or internet access for direct factory support to the Vendor. The factory level support to include diagnostics and troubleshooting support on systems related issues at no additional cost to the Owner.
- D. Access Control Software Upgrades: Version upgrades and "fix" releases to the access control system software are available at no extra charge as long as the version of software provided in this Specification remains the current Manufacturer's version or for up to 2-years after a new version release.
 - 1. Major access control software revisions that provide new functionality to the product provided free of charge for up to 1-year from the date of substantial completion.

2. Access control system software is to be upgradeable as may be required or as necessary, to expand and manage the Owner's site or sites. Upgrades are to be offered at a published flat fee for the primary system software, with single license modules included in the primary fee structure. System upgrades offered at a costing structure based upon the original number of licensed modules issued, or on those to be purchased at a future date, are not allowed.
3. As part of the submittal package, provide a list of available software upgrades and/or expansions modules. List to identify related costs for upgrades, or expansions to the original system, up to the next qualifying operational level.

1.09 SCOPE OF WORK

- A. Access Control Site Management System: Furnish and install at the indicated locations the specified integrated access control door hardware and access control system firmware and software for a completely operational access control and security site management system. System includes, but is not necessarily limited, to the following:
 1. Electrified integrated access control locks and exit hardware, network control processors, reader controller panels, I/O monitor/control interfaces, door position switches, remote card readers, keypads, and display terminals, access cards and credentials, system application software, special tools, operating manuals, and required cabling and accessories as detailed below and listed in the Access Control Hardware Sets at the end of Part 3.
 - a. Provide the appropriate number of reader controller panels and I/O monitoring / control expansion interfaces as needed to handle the number of card readers, locking devices, door status devices, and identified alarm inputs specified in this Section, and as shown on the Security Drawings.
 - b. Provide Manufacturer approved integrated access control locks, exit hardware, and remote mounted card readers, keypads, and display terminals that are functionally compatible with the specified access control equipment interfaces.
 2. Access control system equipment to be installed in an enclosure box compatible with the specified components. This enclosure to include, but is not necessarily limited to, the network control processor, I/O monitor/control interface panels, power supplies, terminal strips, wire ducts, keyed lock cylinder, integrated outlet for A/C power and standoffs.
 - a. Enclosure box to be located in the designated IT/Telecom room(s) with connection to the Owner designated local area network for communication back to the central server host.
 3. Owner to provide the following:
 - a. Computer hardware and peripherals to be from an approved, Major Line Computer Manufacturer. The following Manufacturers will be considered "pre-approved", however, specific information detailing compliance with the Manufacturer's Requirements must be included within the Project submittal package as specified.
 - 1) Compaq
 - 2) Dell
 - 3) Hewlett-Packard
 - 4) IBM

- b. Central Server Host Computer:
 - 1) System Server to include the following Minimal Requirements: Windows Server 2003 (Service Pack 1 or higher) or later Operating System, Intel Pentium IV 1 GHz (equivalent or greater), SQL Server 2005 Express Edition or SQL 2005, 1GB Ram or larger, 120GB hard disk space available or more as needed, CRT or LCD minimum 15-inch display Monitor, CD/RW Drive. Single serial port, or multiple USB ports, and one parallel port, keyboard and mouse.
- c. Client Workstations:
 - 1) Client Workstation to include the following minimal Requirements: Windows XP Professional (Service Pack 2 or higher) or Windows Vista Business, Intel Pentium III 500 MHz (equivalent or greater), SQL Server 2000 Client Access License, 1GB Ram or larger, 30GB hard disk space available or more as needed, CRT or LCD minimum 15-inch display Monitor, CD/RW Drive. Single serial port, or multiple USB ports and one parallel port, keyboard and mouse.
- d. Owner will be responsible for ensuring that each computer hardware component includes the required interfaces, expansion boards, and peripherals that will be necessary to allow the system to operate as described within this Specification and as indicated on the Drawings.
- e. Power Sourcing, Network Switches and Wireless Access Points: Quantity as required to accommodate installed access control (and video surveillance) devices.
- f. Network Control Processor Connections:
 - 1) LAN/Ethernet communication ports (jacks) and network interface cards as needed, CAT5e (CAT6) cabling from network router/switch to network control processor, outlet and cover plates and/or patch cables required for network connection within each designated IT/Telecom room.
 - 2) Required static IP addresses.
- 4. Power Supplies, including battery or uninterrupted backup powers supply (UPS) and separately fused surge protection, required for the electrified door hardware, access control equipment, and PoE switches or wireless routers driving the integrated card reader locking devices.
- 5. Installation, final configuration and commissioning of electrified door and access control system hard-ware, communication firmware, power supplies and related accessories.
- 6. System application software including installation, programming, and end user training of the access control system demonstrating operating, repair, and maintenance procedures. Include on-site central server training for designated Personnel (facilities maintenance, security, IT, administration) by a Factory Certified Representative.
 - a. Include Client Software Application (client workstation) training at each of the remote installed facilities for local Administrative Staff.
- 7. Provide Manufacturer required power controllers, interface boards, and programming that may be required for approved electric latch retraction exit devices supplied under Division 08 Section "Door Hardware."
- 8. Electrical Contractor, Division 26, to provide the following:
 - a. Source power wiring (120VAC) as required for the integrated locking and access control hard-ware, equipment, accessories and power supplies. This includes quad outlets as required on a dedicated circuit in the designated IT/Telecom room(s) and

- the related conduit, stub-in, junction boxes and connectors required for the source power delivery and connections.
- b. Provide required conduit, stub-in, junction and back boxes for both the electrified locking hardware and access control equipment at each of the access controlled or monitored openings per Plan Drawings and Specifications. Supply and install conduit between each of the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.
 - 1) At wall mounted remote readers, provide conduit on the secured side of the door, 36-inches from the finish floor and 6-inches from the edge of the frame, to the related power supplies and access control equipment.
 - 2) At electrical hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.
 - c. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.
9. Access Control System Integrator to provide the following:
 - a. Low voltage wiring (12/24VDC) and communication cabling (RS-232/RS-485) from network control processors to reader controllers, I/O monitor/control interface panels, electrified and integrated locking hardware, remote card readers, keypads, or display terminals, monitoring and signaling switches, and power supplies. Work includes related connectors, final terminations, and hook-ups required for a complete and functional access controlled opening in accordance with applicable Codes and specified system operational narratives.
 10. Elevator Contractor to provide the following:
 - a. Interface or landing of interface cable onto the elevator call button will be performed by a Certified Elevator Contractor.
 - b. Coordinate with access control systems integrator provisions for a card reader with output allowing the elevator call button to be activated. A validated card read will be required for activation.
 11. Full and seamless integration of the analog, digital or IP-enabled CCTV video surveillance system (Division 28) if applicable, with the installed site access control system software.
 12. Full and seamless integration of the site intrusion alarm service and motion detector systems, (Division 28) if applicable, with the installed site access control system software.
 13. Final connections to fire alarm system, if required, by Electrical and Fire Alarm System Contractors.
 14. Provide permits, submittals and approvals required by the authority having jurisdiction, prior to commencing with work.

PART 2 - PRODUCTS

2.01 SYSTEM ARCHITECTURE - ACCESS CONTROL SITE MANAGEMENT SYSTEM (ACSMS)

- A. General: The ACSMS is a modular and networked based system providing physical access control security to a Wide Area District, campus or educational enterprise. The system to be capable of controlling and integrating multiple security functions including the configuration, management and monitoring of cardholder access, locking hardware units, events, alarms, visitors, and real-time tracking and reporting. The ACSMS is to be alterable at any time depending on the Facility Requirements and will allow for easy upgradeability or modification of network processors, controller, interface modules, card data, inputs, outputs, and remote work stations. The ACSMS to include, but is not limited to, the following features and functions:
1. An "Enterprise" class access control software application.
 2. Client/Server model operating central server host software modules and client workstation software applications in a multi-user and a multi-tasking environment.
 - a. The ACSMS to permit multiple instances of client software applications to run simultaneously on the network. The base system to include software application licenses with an unlimited number of licenses available subject to connection fees.
 3. Partitioning: The system to support security partitioning enabling system administrator to segment the configuration database and group multiple entities within the security partition.
 - a. Security partitions limit what users can view in the configuration database. Administrators, who have all rights and privileges, can segment a database into multiple security partitions. A user who is given access to a specific partition will only be able to view entities (components) within the partition they have been assigned.
 4. Encryption: The system to support encrypted communication between the central server software and client software applications (server-to-server and client-to-server) using a 128-bit AES encryption algorithm (at a minimum).
 - a. Communication between the central server host software module and system controllers to be encrypted if supported by the controllers.
 - b. The ACSMS client software applications to be password protected with passwords stored in the central server database in an encrypted manner.
 5. Distributed Processing: The system is a fully distributed processing application allowing information, including time, date, zones, valid Codes, tasks, access levels, and similar data, to be downloaded from the central host station to controller interface devices allowing access-control decisions with or without central host station communication. If communications to a central host station are lost, the controllers will automatically buffer event transactions until communications are restored and events are automatically uploaded to the central host station.
 - a. Provide for a higher level of distributed database management at defined perimeter access points such that no single point of failure will allow more than two access points to fail, or affect more than two access points at perimeter points system wide.

6. Single Data Base: The system to support a single database for access control site setup, credential and identity file creation, alarm and control setup, and system user operation and command functions.
7. System Access Management: The system to allow operators through password authentication the ability to make access granted or denied decisions, define access levels, time zones, holidays, assign cardholders, access groups, develop tasks, and generally manage access control, alarm monitoring and response activities system wide from a single login. Operator and user privileges are managed by a system administrator allowing for different levels of system access and system control. Authorization management is fully Owner definable.
8. Cardholder Management: The system to include a cardholder management system integrated within the access control system. This cardholder management functionality allows the enrollment of card-holders into the database, and import/export of employee data.
9. Access Groups and Access Levels: The system to provide adequate access groups and access level assignment capability to meet Owner Requirements for the specified project. If required, software application can be expandable to support unlimited access groups and access levels.
10. Alarm Monitoring: The system is able to monitor, report, and provide information about the time and location of alarms, along with their priority.
11. Event Monitoring: The system is able to monitor, report, and archive network access control activity.
12. Transaction Logs: The system to support an unlimited number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
13. System Monitoring: The system to have ability to report on the integrity of all network assigned devices, circuits and communications and provide a diagnostics screen showing field level communications system wide
14. Lock/Unlock Commands: The system to allow an operator to manually lock and unlock doors over-riding scheduled access control restrictions and configurations if necessary.
15. Hardware Interface: The system to integrate with and control specified electrified hardware, signaling and monitoring devices.
16. Report Generator: The system to have the ability to generate and output reports with any and all combinations of system fields and data including, but not limited to: by cardholder, by door, by site, by time, by groups of doors and by cardholder field. Any and all combinations of fields must be available for reporting. The report feature to allow exporting of generated reports over a network connection or by remote printing.
17. Multi-User/Web Based Network Capabilities: The system to support multiple operator workstations via Local Area Network/Wide Area Network (LAN/WAN), the Internet, or VPN. The system to be capable of supporting minimum number concurrent Users/ Clients with software expansions to an unlimited number of workstations based on the Owners Network Requirements.

18. Systems Integration: The system to have the ability to be fully and seamlessly integrated with existing or specified intrusion detection alarm and video surveillance (CCTV) systems.
- B. Open Architecture: The access control system infrastructure will be based on an open Architecture Design capable of supporting multiple Access Control Hardware Manufacturers and integrate with multiple non-proprietary network processors, controllers, interface modules, integrated locking hardware, remote card readers, keypads and display terminals, and other third party applications.
- C. Network Support: Communication network connecting the central server host software modules, Client work-station software applications, and hardware controllers to be designed to support all of the following:
 1. LAN/Ethernet enterprise ring topology and localized star topology based on TCP/IP.
 2. Direct-connected RS-232 and RS-485 communication cabling.
 3. Dial-up modem connection using a standard dial-up telephone line.

2.02 MANUFACTURERS

- A. Approved Access Control and Site Management System Manufacturers:
 1. Corbin Russwin (Integrated Access Control Locking Devices and Accessories).
 2. HID Global (Access Cards and Credentials, Remote Readers).
 3. Sargent Manufacturing (Integrated Access Control Locking Devices and Accessories).
 4. Securitron Corporation (Power Supplies).
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. General: Provide integrated access control door hardware and access control system equipment and accessories for each designated opening to comply with Requirements in this Section and with the Access Control Hardware Sets listed at the end of Part 3.
 1. Access Control Hardware Sets: Requirements for quantity, item, model, design, grade, finish, size, and other distinctive qualities of each type of integrated door and access control hardware are indicated in the Access Control Hardware Sets at the end of Part 3.
 2. Named Manufacturer's Products: Product designation and Manufacturer are listed for each door hardware type required for the purpose of establishing Minimum Requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. System Design: The equipment and materials supplied are to be standardized components regularly manufactured and utilized within the Source Manufacturer's access control systems.
 1. System components to be non-proprietary in design and implementations, providing for an open protocol platform with multiple Manufacturers having functional software capable of integrating with the hardware specified. The installed integrated product is to be part of a single, cohesive management and access control system.
- D. Substitutions: Requests for substitution and product approval for inclusive integrated access control door and access control systems hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Section 01 33 00 - Substitution Procedures. Approval of requests is at the discretion of the Architect, Owner, and their Designated Consultants.

1. The access control system described in this Specification represents a complete engineered system. If alternate products are submitted, it is the responsibility of the Supplier/Dealer/Integrator to provide an acceptable complete and working system layout, including re-engineering of elevation and wiring diagrams, as applicable. Complete systems to include at a minimum required power supplies, power transfers, and integrated access control locking hardware and accessories.

2.03 ACCESS CONTROL AND SITE MANAGEMENT SYSTEM HARDWARE

- A. General: Provide all necessary access control field hardware devices required to receive alarms and administer all access granted/denied decisions. Field hardware devices must be designed and installed in accordance with applicable Electrical Codes.
- B. Central Computer Host Server (Owner Provided): The central host server is interconnected to all system components, including client workstations and field installed controllers, providing operator interface, inter-action, display, control, and real-time monitoring.

2.04 INTEGRATED IP-ENABLED ACCESS CONTROL DEVICES

- A. IP Enabled Power-over-Ethernet (PoE) Integrated Card Reader Mortise Lock: IP enabled ANSI/BHMA A156.13 Grade 1 mortise lockset with integrated credential reader, request-to-exit, and door position signaling in one complete unit. Motor driven locking/unlocking control of the lever handle trim, 3/4-inch projection latch bolt, and optional 1 inch steel deadbolt. Lock is UL listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - IN220 Series.
 - b. Mortise locks - IN220-ML20234 B OA BIP PSA M17 CT6R 626
 - c. Exit Devices - ED5200N IN220 PR9134 B OA BIP 5CH M110 CT6R 630 - Special App request for 5CH
 - d. Fire-Rated Exit Devices - ED5200AN IN220 PR9134 B OA BIP 5CH M110 CT6R 630 - Special App request for 5CH
 - e. Substitutions: See Section 01 62 00 - Product Options.
 2. Operational Narratives required at ALL Card Access openings.
 3. Completely intelligent and integrated locking unit with Ethernet power and communication connection capability directly from the locking unit back to the central system host server without additional access control interfaces or components (excluding PoE Endspan and Midspan devices) via an existing or newly installed IEEE 802.3af PoE enabled network.
 4. Open architecture design supports wired integration with third party access control systems applications via software development kit (SDK). Real-time software accessible alarms for forced door, unknown card and door held open, with inside lever handle (request-to-exit), battery status, tampering, and door position (open/closed status) monitoring.
 5. 2,400 users and 10,000 event transaction history (audit trail). Distributed intelligence allows stand-alone operation in absence of network communication allowing for system operational redundancy.

6. Provide a network and lock configuration CD tool kit for initial lock setup and programming via a USB connection.
7. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
8. Integrated reader supports the following credentials:
 - a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
 - b. 13.56 MHz contactless credentials: HID iClass, HID iClass SE, HID iClass Seos, SIO on MIFARE Classic, SIO on MIFARE DESFire EV1, MIFARE Classic, DESfire EV1, NFC-enabled mobile phones, Bluetooth Smart-enabled mobile phones.
9. Communication between access control system and device is protected by AES 128 bit encryption via the SDK. Programmable for time zones, holidays and automatic unlocking.
10. Power and communication from one Ethernet (CAT5e or higher) cable. Compliant with IEEE 802.3af Class 1 device specifications requiring 3.84 watts for Power over Ethernet.
11. Supports real-time system lockdown capabilities. Inside lever retracts latch bolt and dead bolt simultaneously.
12. High security mechanical key provides emergency override retraction of latch-bolt without need for electronic activation.
13. Ethernet system framework, network cabling, mounting boxes, PoE end-span/mid-span, electrical hard wiring, grounding, and connections are required for complete system functionality. All system components are by others and are specified elsewhere.
 - a. Power Requirement: PoE Class 2, maximum 7 watts.
 - b. Network Cabling Requirements: Cat5e or higher meeting or exceeding ANSI/TIA/EIA-568-C. 24 AWG Plenum rated.
 - c. Bonding and Grounding: Meet or exceed TIA-607-B Requirements. Connect device ground cable to building electrical earth ground.
 - d. Network Surface Mount Box: Meet or exceed ANSI/TIA/EIA-568-C Requirements. CAT5e or higher (RJ45).

2.05 CABLES AND WIRING

- A. Comply with Division 26 and 27
- B. Data Line Supervision: System to include alarm initiation capability in response to opening, closing, shorting, or grounding of data transmission lines.
- C. Install appropriate number of conductor pairs, in the wire gage (AWG) recommended by Manufacturer, corresponding to the electronic locking functions specified, amperage drawn and distances covered between the power supplies, power transfer devices, electrified hardware and access control equipment.

2.06 FABRICATION

Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to Manufacturers recognized installation standards for application intended.

2.07 ACCESS CONTROL HARDWARE FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain Manufacturers for their products.
- B. Protect mechanical finishes on exposed surfaces from damage by applying temporary protective coverings before shipping.
- C. Where specified, finishes on integrated card key locksets or exit hardware to incorporate an FDA recognized antimicrobial coating (i.e., MicroShield™) listed for use on equipment as a suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with Requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of the installed access control system.
- B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified and integrated access control door hardware installation.
- C. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- D. Notify Architect of any discrepancies or conflicts between the Specifications, Drawings and Scheduled access controlled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

Doors and frames at scheduled access controlled openings to be properly prepared to receive specified electrified and access control hardware and connections without additional in-field modifications.

3.03 INSTALLATION

- A. Install each item of integrated access control door hardware and access control equipment to comply with Manufacturer's written instructions and according to Specifications.
- B. Mounting Heights: Mount integrated access control door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with Governing Regulations:
 - 1. Standard Steel Doors and Frames: DHI (LOCS).
 - 2. Wood Doors: DHI WDHS.3.
 - 3. Where indicated to comply with Accessibility Requirements, comply with CBC Chapter 11B.

- C. Boxed Power Supplies: Verify locations.
 - 1. Configuration: Provide the least number of power supplies required to adequately serve doors with access control hardware and equipment.
- D. Integrated Wiegand access control products, campus locks, and IP enabled products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.
- E. Final connect the system control switches (integrated access control door hardware, remote readers, keypads, display terminals, biometrics), and monitoring, and signaling equipment to the related controller devices at each opening to properly operate the electrified door and access control hardware according to system operational narratives.
- F. Retrofitting: Install each door hardware and access control item to comply with Manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- G. Networked System Application Software: Install, and test application(s) software and data-bases for the complete and proper operation of systems involved. Assign software license(s) to Owner.

3.04 FIELD QUALITY CONTROL

- A. Field Inspection: Perform a final inspection of the installed integrated access control door hardware and access control system and state in report whether installed work complies with or deviates from Requirements, including whether each component representing the opening assembly is properly installed, adjusted, operating and performing to system operational narratives.
- B. Commissioning and Testing Schedule: Prior to final acceptance of the access control system installation, the following testing and documentation to be performed and provided to the Owner.
 - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
 - 2. Pre-testing: Program and adjust the system and pretest all components, wiring, and functions to verify they conform to Specified Requirements. Provide testing reports indicating devices tested, pass/fail status, and actions taken to resolve problem(s) on failed tests.
 - 3. Acceptance Test Schedule: Correct deficiencies identified by tests and observations and retest until Specified Requirements are met.
 - 4. Provide "As Designed" Drawings showing each device and wiring connection and electronic enclosure legends indicating cabling in and out.
 - 5. Provide a complete set of operating instructions for access control hardware devices and a complete software user manual. The documentation includes module reference guides for each electronic enclosure.

3.05 ADJUSTING

Adjust and check each operating item of integrated access control door hardware, and each door opening to ensure proper secured operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

3.06 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all integrated access control door hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by access control system installation.
- C. Clean operating items as necessary to restore proper finish and provide final protection and maintain conditions that ensure access control door hardware is without damage or deterioration at time of Owner occupancy.

3.07 DEMONSTRATION

Instruct Owner's Maintenance Personnel to adjust, operate, and maintain electronic integrated door hardware and the access control system.

3.08 ACCESS CONTROL HARDWARE SETS

- A. The hardware sets listed represent the design intent and direction of the Owner and Architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the Architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Refer to Section 08 06 71 - Door Hardware Schedule for hardware sets.

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SECTION 28 46 20
FIRE ALARM

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26, 27 and 28.
 - 2. General Provisions and Requirements for electrical work.
- B. This Specification provides the Minimum Requirements for the Fire Alarm and Detection System. The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:
 - 1. Smoke and fire detection.
 - 2. Off-premise notification.
 - 3. Mass Notification system.
 - 4. One-way voice communication notification system.
 - 5. Two-way voice communication system.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit eight copies of the following to the Architect for approval.
 - 1. A listing of all fire alarm components and equipment including the California State Fire Marshal (CSFM) listing numbers.
 - 2. CSFM listing sheets of all devices being used.
 - 3. Manufacturers' standard catalog data for fire alarm components.
 - a. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed Model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure.
 - b. The Manufacturers' data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of item. The data sheet shall completely describe the proposed item.
 - c. Where modification to the equipment is necessary to meet the Operational Requirements of the Contract Documents and the data sheets shall include complete Mechanical and Electrical Shop Drawings detailing the modification.
 - 4. A listing of the outlet rough-in needed for every device and equipment item. The applicable symbol which illustrates that rough-in item on the Job Plans shall be drawn on

the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel.

5. Elevation and dimensional information.

1.03 APPLICABLE STANDARDS

- A. The Equipment shall be listed, labeled, and approved for the application shown in Contract Documents, as fire alarm equipment complying with the following Requirements:
 1. List of applicable Codes:
 - a. Building Standards Administrative Code, Part 1, Title 24 C.C.R.
 - b. California Building Code (CBC), Part 2, Title 24 C.C.R.
 - c. California Electrical Code (CEC), Part 3, Title 24 C.C.R.
 - d. California Mechanical Code (CMC), Part 4, Title 24 C.C.R.
 - e. California Plumbing Code (CPC), Part 5, Title 24 C.C.R.
 - f. California Fire Code (CFC), Part 9, Title 24, C.C.R.
 - g. California Referenced Standards Code, Part 12, Title 24, C.C.R.
 - h. Title 19, C.C.R., Public Safety, State Fire Marshal Regulations.
 - i. California Energy Code (CEC, Part 6, Title 24 C.C.R.
 2. NFPA Standards and Guides:
 - a. NFPA 13, Automatic Sprinkler Systems.
 - b. NFPA 14, Standpipes Systems.
 - c. NFPA 14, Dry Chemical Extinguishing Systems.
 - d. NFPA 17A, Wet Chemical Systems.
 - e. NFPA 24, Private Fire Mains, (included the latest NFPA 13).
 - f. NFPA 72, National Fire Alarm Code, (California Amended).
 - g. NFPA 253 Critical Radiant Flux of Floor Covering Systems.
 - h. NFPA 2001, Clean Agent Fire Extinguishing Systems.
 3. The fire alarm system shall conform to the applicable Standards and Guides referenced in CBC Chapter 60.
- B. Written Certification by the Fire Alarm Equipment Manufacturer shall be submitted to the Architect, stating that the system and its component parts are listed and approved by the California State Fire Marshal and the Installation has been Tested, is Operational and Conforms to the Requirements as set forth in Part 3, Article 24, Title 19, California Code of Regulations.

1.04 EQUIPMENT AND INSTALLING QUALIFICATIONS

- A. The Equipment shall be manufactured by Simplex to match existing fire alarm equipment on the Campus.
- B. The Specification is based on the equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the Requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer's data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.

- C. All equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.
- D. To Qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be qualified Fire Alarm Contractor and shall hold a valid C10 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction over the work. The Contractor shall be the Factory Authorized Distributor for the branch of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall be financially able to provide a performance bond covering the work and the guarantee described. The Contractor shall provide that bond if requested.
- E. Installation Certification
 - 1. Work and material for cables, cable terminations and related components shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.
 - 2. The Manufacturers of the indicated work and material shall provide an Installer Education/Training and Certification Program for the supplied products.
 - 3. The Installers performing the Contract work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.
 - 4. Submit six copies of the Manufacturer's Certifications for each Installer performing the work. The submittal shall be approved prior to initiating any related Contract Work.
 - 5. Contract material installed and work performed by Installers not complying with these Requirements shall be removed. Removal of work and material not in compliance with these Requirements shall done at the Contractors' expense, without any additional cost to the Contract and without any Additional Contract completion due date extensions. New material and work required to replace the non-complying removed work and material shall be provided at the Contractors' expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

PART 2 - PRODUCTS

2.01 GENERAL SYSTEM OPERATION

- A. System shall be microprocessor-based, addressable, and power-limited with Class B supervised circuits, one-way and two-way emergency audio communications.
 - 1. The microprocessor shall execute all supervisory and control programming to detect, report the failure or disconnection of any system module or peripheral device and initiate programmed control sequences. An isolated supervision "watchdog" circuit shall monitor the microprocessor and, upon failure, shall activate the system trouble circuits.
 - 2. The automatic fire detection and alarm system shall consist of main control panel, transponder panel(s), notification alarm devices, remote annunciator, automatic

detection devices, manual stations, printer, and CRT/keyboard, installed and wired in accordance with the Drawings and shall function as specified herein.

3. The system shall be programmable in the field, by a non-computer trained person. All programmed information shall be stored in non-volatile memory.
4. The system shall operate both addressable and non-addressable ionization, thermal and photoelectric detecting devices, manual stations, water-flow switches, and external control modules.
5. The control panel shall provide power, annunciation, supervision and control for the fire detection and alarm system. The system shall be designed such that alarm indications override trouble and control conditions.
6. External Circuit Supervision shall not require additional wires other than the pair used for detection or alarm (only two wires shall be used from the control panel to each loop of initiating devices and two wires for the notification alarm devices). These two wires shall provide both supervision and notification alarm signals. There shall be no loss of Supervision for Class "B" wired addressable devices. Class "A" Supervision may be provided by adding an additional pair of wires.

B. Alarm Conditions

1. Actuation of any manual or automatic alarm initiating device, connected to the system shall cause the following automatic functions.
 - a. All notification alarm signaling units shall activate continuously. Audible notification alarms shall sound the California State Coded Signal.
 - b. The respective zone alarm lamp or annunciator alphanumeric readout on the central control panel, and remote annunciator panel, shall be activated.
 - c. Activate the Digital Alarm Communicator system.
2. Actuation of HVAC air duct smoke detectors shall stop the designated fans and motors in the building's air distribution system.
3. Actuation of smoke detectors on either side of smoke doors shall energize the release mechanism on the smoke door causing the door to close.
4. Notification alarm signal duration shall be capable of continuous sounding or adjustable from 3 to 10-minutes.
5. Perform any additional functions as specified herein or shown on the Drawings.

C. Trouble Condition

1. A single open or single trouble condition in a manual or automatic fire initiating wiring circuit shall activate the respective zone trouble lamp or annunciator readout on the fire alarm control panel and sound a trouble signal at the control panel.
2. A single open or single trouble condition in the notification alarm signaling wiring circuit shall activate the trouble lamp or annunciator readout in the control panel and sound a trouble signal at the control panel.
3. 120 volt AC normal power shall be monitored with indication by a "power on" lamp. Upon normal power outage, the system shall activate power trouble condition lamp or annunciator readout, and indicate a trouble condition.

4. The control panel shall monitor the standby batteries and, upon a low battery condition, activate the low battery lamp or annunciator readout and indicate a trouble condition.
 5. System ground detection shall be provided for the entire system. Upon ground detection, activate the ground detection lamp or annunciator readout and indicate a trouble condition.
- D. Control panels employing alphanumeric readouts shall display the trouble condition along with a prompt to review the list chronologically. The end of the list shall be indicated.

2.02 FIRE ALARM CONTROL PANEL

A. General

1. The fire alarm control panel shall be software programmable, microprocessor controlled, solid state, electronic integrated system. The panel shall be the product of one Manufacturer. The control panel shall provide power, annunciation, supervision and control for the detection and alarm system. The detection system shall remain 100% operational, responding to an alarm condition while in the routine maintenance mode.
2. Addressable detection and control devices shall be individually identified by the system, and any quantity of addressable detection devices shall be in alarm and any quantity of addressable control units shall be operable at any time up to the total number connected to the system.
3. The microprocessor shall access the system program, which is stored in non-volatile programmable memory, for all Control-By-Event (CBE) functions. The system program shall not be lost upon failure of both primary and secondary power. Volatile memory shall not be acceptable.
4. A means shall be provided for acknowledging each abnormal condition. Each activation of the appropriate acknowledges button shall sequentially acknowledge every point in the system. After all the points have been acknowledged, the LEDs shall glow steady and the panel audible signal will be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be so indicated.
5. An alphanumeric annunciator readout shall indicate on the control panel the activation by type, loop, and address of the specific device, sub-loop or alarm/monitor/control point via an alphanumeric display. An audible alert shall sound at the control panel and an alarm light shall flash.
6. If the microprocessor fails, the system shall executive a default signaling program. This program shall enable the control panel to sound the audible signals and summon the Fire Department. In addition, a red LED shall light to indicate the communication loop where-in the alarm originated. Inability of the system to sound signals or summon the Fire Department during microprocessor failure shall not be acceptable.
7. Protected access to the system controls shall be provided to allow the user/operator access to the following system functions:
 - a. Status of all addressable points.
 - b. Status of all events logged.
 - c. Set/change the real-time clock and date.

- d. Perform an operational manual test of the system from the control panel, including actuation of any initiating device and trouble circuit without alarming the remote central station. The panel shall automatically return to normal mode in the event the panel remains unattended in the service mode.
 - e. Retrieve from event log the last 300 alarms, or control points and 300 trouble conditions.
8. Individual input (monitor) and output (control) device addressability shall all be performed on the same pair of wires. Wiring shall be Class "A" or "B". When Class "B" wiring is used, no special wiring sequence shall be required on addressable device circuits. An unlimited number of wiring branches shall be permitted with no loss of supervision.
9. A minimum of 25% addressable monitor, trouble and control points shall be provided.
- B. Cabinet**
- 1. A metal tamper resistant cabinet shall contain the control panel components. Panel shall be surface or flush mounting as indicated on the Drawings. Provide a full height tamper resistant hinged locking cabinet door. The door shall have transparent, high impact windows to allow visual observation of all indicators and switches without opening the panel door.
 - 2. "In-out" circuit conductors shall terminate on numbered screw-type terminals.
 - 3. All groups of circuits or common equipment shall be clearly marked and shall be expandable by inserting interchangeable units.
- C.** The Control Panel shall provide positive protection against the fire alarm system inadvertently being left in a non-operating status. The alarm system shall automatically restore and resound alarms and trouble signals, if subsequent alarm initiating or trouble signals are received under any of the following conditions:
- 1. After the alarm or trouble silence switch have been activated.
 - 2. Prior to resetting system after previous alarm or trouble conditions.
- D.** The System Indicating and Operational Control Devices shall be mounted on the control panel face behind the panel door and shall provide the following minimum functions:
- 1. Individual visual indicating pilot lights annunciator or alphanumeric readout to monitor the following alarm system conditions:
 - a. Input power.
 - b. System common alarm.
 - c. System common trouble.
 - d. Alarm or trouble signal silenced.
 - e. Ground fault.
 - f. Battery condition.
 - g. Each individual alarm, control or initiating zone-activation.
 - h. Each individual alarm, control or notification zone-trouble.
 - i. Report, by specific device number, any device removed from an addressable initiating circuit, all other devices shall continue to function.

2. Manual control switches to allow the following system controls:
 - a. Alarm silence.
 - b. Trouble silence.
 - c. Test all indicating pilot lights and readouts.
 - d. System reset, including remote devices connected to the alarm panel.
 - e. Alarm test to initiate an alarm condition from the control panel.
 - f. Alarm disconnect for system testing without activating the Digital Alarm Communicator system.
 - g. Changing the status of configured circuits (arming or disarming and changing status of relays). If any change in status degrades system operation as configured, a trouble condition shall be reported and remain until system operation again meets configured status.
 - h. Perform multiple operations at the same time. These operations shall include but not be limited to timed functions and multiple configured sequences.
- E. Alarm Initiating Zone Modules.
 1. Shall supervise and accept remote alarm actuating device input signals. An alphanumeric readout shall indicate separate zone alarm and trouble indicators for each zone.
 2. Zones shall be compatible, and designed to operate with the connected initiating devices either addressable or non-addressable type.
 3. A spare double throw set of software programmable auxiliary alarm relay contacts shall be provided for control of remote devices for each zone. Contacts shall be rated 120-volt 60Hz 3-amp.
 4. Each device on the system shall report as its own unique address.
- F. Notification Alarm Signal Control.
 1. Shall supervise and activate remote notification alarm devices.
 2. Notification alarm shall be compatible and designed to properly operate with the connected audio and visual notification alarm devices, with no signal degradation.
 3. The notification alarm shall provide group notification signal control of all notification zones.
 4. The alarm modules shall be field resettable to provide either continuous or coded notification alarm signals. The coded alarm signal shall provide an intermittent "on-off" pulsed sound activation of audible notification alarm devices.
 5. A notification alarm circuit trouble indicating readout shall be provided for each notification zone.
- G. Audio
 1. The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over

supervised circuits. The one-way emergency audio control shall provide control switches to direct paging messages as follows:

- a. "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.
 - b. "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
 - c. "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.
 - d. "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
 - e. "Page by Phone" switch to select the Firefighters telephone system as the source for paging.
2. The system shall be capable of delivering multiple audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way emergency audio control unit. The one-way emergency audio control unit shall store pre-recorded audio messages digitally. These messages shall automatically directed to various areas in a facility under program control. The system shall support remote panels with zoned amplifiers to receive, amplify, and distribute messages through speakers over supervised circuits.
 3. The two-way voice communications control unit shall provide two-way communications between remotely located phones and the command center. The control unit shall provide the ability to individually select and display each two-way voice communication circuit support up to five remote telephones in simultaneous two-way voice communications.
 4. Audio Amplifiers (Multi-Channel)
 5. Provide one 20-watt audio amplifier per paging zone. There will be a total of two 20-watt amplifiers (one per floor). The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated, selectable 25/70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.
- H. Automatic ground detection shall detect either positive or negative voltages when earth connections of 50,000 OHMS or less occur, and activate the ground trouble signal.
1. A ground fault code shall provide indication of either a positive or negative ground fault and shall operate the general trouble devices as specified herein but shall not cause an alarm to be sounded.
 2. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored for short circuits and shall have a distinctive error message for visual indication of circuits and operating trouble devices as specified herein but shall not cause an alarm to be sounded.

I. Power Supply

1. The dedicated power supply shall be adequately sized to properly operate the equipment, including remotely connected, spare and future indicated equipment with all alarm devices in alarm condition. Provide 20% spare power supply capacity for future expansion. Provide transfer modules and multiple power supplies as required for proper operation.
2. Input voltage 120/240 volt or 120/208 volt 60Hz AC.
3. Surge protection device on the input and output phases of the power supply shall be provided.
4. Supervised voltage types (i.e., 120-volt, 60Hz AC, 24 volt, AC, 24 Volt D.C., etc.) required by special connected equipment shall be supplied, including but not limited to:
 - a. Alarm initiating devices.
 - b. Notification alarm devices.
 - c. Control and annunciator panels.
 - d. Fire and smoke dampers.
5. A solid-state power transfer circuit shall provide (UPS) Uninterrupted Power Supply between internal standby power and line power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions).
6. Individual circuit fuses shall be provided for smoke alarm detector power, main power supply notification circuits, battery standby power, and auxiliary output.
7. Provide lock-on device on each power supply dedicated branch circuit breaker at panel.

J. Battery Back-Up Operation

1. Internal batteries and battery power supplies shall be provided to allow 60-hours continuous automatic normal operation of the entire control panel and fire alarm system after the failure of the incoming utility power. Sufficient battery capacity shall remain at the end of 60-hour period to provide 10-minutes of continuous operation of all connected notification alarm devices.
2. Batteries shall be maintenance free, sealed, lead-acid or lead calcium or gelled electrolyte type rated 25% larger than required to provide power for the entire system upon loss of normal 120 VAC power for a period of 60-hours with 15-minutes of alarm signaling at the end of this 60-hour period.
3. The battery charger shall be automatic, dual rate with capacity to recharge completely discharged batteries in 18-hours. Charger shall be temperature compensated.

K. Lightning and transient voltage surge protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.

L. Circuitry shall be provided in the control panel to permit transmission of trouble and alarm signals over leased or privately owned telephone cables to a remote receiving panel. A reverse polarity or a master box circuit as required shall be provided in the control panel. There shall be a supervised disconnect switch to allow testing of the fire alarm signal without transmitting an alarm signal to the central station.

- M. The Alphanumeric Annunciator (printer and CRT/keyboard) shall list upon request:
1. Alarms with time, date and location.
 2. Troubles with time, date and location.
 3. Status of output functions, "on" or "off".
 4. Sensitivity of addressable smoke detectors.
 5. Detection device number, type and location.
 6. Status of remote relays, "on" or "off".
 7. Acknowledgment time and date.
 8. Signal silence time and date.
 9. Reset time and date.
- N. The System shall also provide the following:
1. Counting the number of addressable detectors within a "Zone".
 2. Which are in the alarm.
 3. Counting "Zones" which are in alarm.
 4. Counting the number of addressable detectors which are in alarm.
 5. Alarm on the system.
 6. Differentiating among types of addressable detectors such as smoke detectors, manual stations, water-flow switches, thermal detectors.
 7. Assigning priorities to types of detectors, zones or groups of detectors.
 8. Cross-zoning.
- O. Control Functions
1. Control functions shall be assigned on the basis of multi-relational system initiation patterns of detection devices including full logic element equations using as "anding" zones, counting zones, counting devices, "anding" groups, conditional "if", "then", "or" programming and "anding" types of detection devices.
 2. Control functions shall be assigned on the basis of, cycle, delay, count, time of day, day of week, day of month and with a holiday schedule of up to 30-holidays per year. Each addressable detection device shall report its condition to the system control unit not less than every 4-seconds in a manner such that failure of the connections to the internal electronics of the device will result in a trouble signal which identifies the specific device involved.
 3. The system shall be field programmable for the response of control points to monitored devices.
 4. The operating software program shall provide programmable control for the Event-Initiated-Programs (E.I.P.) which shall allow automatic operation of system control points in the event of an alarm condition. To program the E.I.P.s, the system shall use a specifically designed user friendly programming language, which shall not require knowledge of the computer programming to learn and understand.
 5. The operating software shall support the following additional capabilities:
 - a. Three levels of designated and unique Priority Alarms for each point.

- b. Designated "Sense Mode" for status interpretation for each point.
 - c. Designated Print/No Print/Vectoring Mode for each point.
6. The input statement defines the conditions required to activate the associated output statement. The input statement shall consist of single or multiple monitor point status, subroutine status, time comparison and the utilization of AND, OR, NOT, COUNT, and DELAY logic functions.
 7. The output statement defines the action to be taken by the control panel. The output statement shall consist of activation/deactivation of single or multiple control functions, subroutines, and remote annunciator status LED's. Output statements shall also include the "Alert" messages.
 8. The software shall provide an "Alert" message, unique to each point in the system, which will provide specific instructions for the operator on duty. These messages shall be up to five lines with up to 70-characters in each line. Each system monitor point shall have five specific alert messages when in alarm. Control points shall also be assigned alert messages.
 9. The hardware and software shall have the capacity to accept up to 64-independent programs. Each program shall have "Edit" or "No Edit" capability. Each program shall be written in an equation format comparable to ladder-logic equations. The Equations shall consist of an input and an output statement.
 10. Provide initial programming services for Coding, Loading and Debugging the initial District specified programs, as part of the Contract.
 11. Programming Command Definition
 - a. Timing command shall provide time delay and time control functions based on internal clock/calendar by time of day; day of week; day of month; month in year.
 - b. Count command shall provide a specific number of events to occur before a control action is initiated.
 - c. Pulse command shall provide on control for a specific period of time.
 - d. Cycle command shall provide on-off control for preset periods of time.
 - e. Print command shall provide printing of specified information after an event occurs.

2.03 FIRE ALARM DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Enclosure shall be red.
- B. Panel shall be solid state with eight zones for off premise monitoring of the fire alarm control panel.
- C. System shall monitor alarm and trouble conditions. System shall be power limited.
- D. System shall include dual telephone line switcher for central station reporting. Telephone lines shall be supervised.
- E. System shall include dual battery harness, batteries, and battery charger.
- F. System shall be UL listed for central station fire signaling systems (NFPA 71).
- G. System shall be California State Fire Marshal approved for central station reporting.
- H. System shall be Radionics D8112FA Series or Simplex 5071 Series. System shall be approved for connection to the fire alarm control panel.

- I. Verify Specific Requirements with District and central station prior to submittals.

2.04 MANUALLY ACTIVATED ALARM INITIATING DEVICES

Manual fire alarm boxes shall comply with CBC Sections 11B-309 and 11B-403.

- A. An electronic, digital multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
- B. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit.
- C. Numbered screw type terminals shall be provided for "in-out" connections of the alarm circuit wiring.
- D. The face of the station shall have lettering indicating "FIRE" and operational instructions. Stations shall be tamper resistant, semi-flush mounting.
- E. Auxiliary spare switch contact shall be provided for control of remote devices rated 120 volts - 60Hz, AC, 3-amp minimum.
- F. Stations shall provide visual indication the station has been activated. A key (and/or special tool) shall be required to gain access into the station to reset the station after being activated.
- G. Stations shall be "nonbreak-glass" type.
- H. RF and transient filtering shall be provided in the device electronics.
- I. Pull stations shall be non-coded double action, requiring a two District manual "pulling" actions to initiate the fire alarm system.
- J. Stations installed outdoors shall be weather resistant construction, double action to activate the pull station.

2.05 AUTOMATIC ALARM INITIATING DEVICES

- A. General
 - 1. An electronic digital, multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
 - 2. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit. Where initiating devices are shown connected to an existing system, devices shall operate on 2 or 4-wire circuits plus, 2-wire power circuit as required by the existing equipment.
 - 3. Numbered screw type terminals shall be provided for "in-out" connectors of the alarm circuit wiring.
 - 4. Auxiliary double throw spare relay contact shall be provided for activation of remote rated devices 120-volt 60Hz, AC, 1-amp minimum.
 - 5. RF and transient filtering shall be provided in the initiating device electronics.
 - 6. Initiating devices shall be reset from the control panel and shall not require individual resetting.

B. Smoke Detector

1. Detectors shall comply with UL Standard 268, 167 and 168, and shall use solid state electronic circuits throughout.
2. The smoke detector shall operate on a total of two circuit wires. Alarm signaling and detector power shall use the same conductors. Detector sensitivity shall be factory set at 1.5%. Provide testing provisions in accordance with CFC 904(a) – 904.2(f), NFPA72.
3. A fine mesh insect screen shall be provided on all detector openings.
4. The detector shall lock-in on alarm and shall provide a visual alarm/trouble indicator light. An electromechanical test feature shall provide functional testing of the unit without smoke.
5. The detector shall also incorporate a fixed temperature heat detector rated at 135 degrees F. The heat detector shall operate the alarm circuit and alarm/trouble light.
 - a. Photo electric type smoke detectors shall employ a Light Emitting Diode (LED) as the detector light source, activated by the presence of combustion smoke products. Failure of the LED shall activate the alarm/trouble light on the detector.
 - b. Ionization type smoke detector shall employ the triple chamber (dual chamber) ionization principle, activated by the presence of combustion products. The ionization chamber shall be RF shielded.
 - c. Air duct smoke detector photo electric or ionization type for installation on a mechanical air ducts. Two air tubes shall extend into the air duct. The sampling tube shall extend across the entire width of the air duct. The second tube shall allow air to escape back into the duct.

C. Fire Detector - Heat

1. Heat detectors shall be dual action electro-thermostatic combination rate of temperature rise and fixed temperature operation. An indicator shall be visible when detector has activated.
2. The rate of rise element shall be self-restoring, after activation.
3. The fixed temperature unit shall be set at 136 degrees F (190 degrees F for high temperature areas i.e. over 110 degrees F).
4. Provide a wire guard cover for the detector.

2.06 NOTIFICATION ALARM DEVICES

A. General

1. Notification alarm devices shall activate automatically from the control panel. Devices shall operate on a Class "B" (Style Y), 2-wire supervised alarm notification circuit. Series wired alarm devices shall not be used.
2. Numbered screw type terminals shall be provided for "in-out" connections of the alarm circuit wiring.
3. Devices shall be installed in a box, 3½-inches deep maximum, flush mounting unless indicated other-wise on the Drawings. Size as required for the alarm indicating device and wiring connections. Provide a trim ring and metal grill cover assembly. Cover assembly shall be a minimum of 1/16-inch minimum thick flat stainless steel or

aluminum. Finish color as selected by Architect. The word "fire" shall appear on the grill minimum ½-inch letters. The grill shall be attached with screws to the box.

4. Each audible notification visual devices shall incorporate a visual alarm indicator. The visual alarm indicating device shall be an integral part of the audible alarm box assembly.
5. Audible notification device and visual notification devices shall be connected to separate notification alarm signal circuits. Do not connect these devices to the same circuit conductors.

B. Notification Appliances

1. Speakers

Low Profile Speaker

Provide low profile wall mount speakers at the locations shown on the Drawings. The low profile speaker shall not extend more than 1-inch (2.5cm) past the finished wall surface and provide a switch selectable audible output of 2w (90dBA), 1w (87dBA), ½w (84dBA), or ¼w (81dBA) at 10 feet when measured in reverberation room per UL-464.

Wattage setting shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring. The low profile speaker shall mount in a North American 4-inches x 2½-inches square electrical box, without trims or extension rings.

2. Speaker-Ceiling Mount-8-inch

Provide 8-inches ceiling mounted speakers at the locations shown on the Drawings. In and out screw terminals shall be provided for wiring. Speaker baffles shall be round or square steel with white finish as required. Provide square surface mount boxes with matching finish where required. Speakers shall provide ½w, 1w, 2w, and 4w power taps for use with 25V or 70V systems. At the 4 watt setting, the speaker shall provide a 94-dBA sound output a frequency of 1000Hz when measured in an anechoic chamber at 10 feet.

3. Speaker-Cone-4-inch

Provide 4-inches white speakers at the locations shown on the Drawings. Speakers shall have a 4-inch Mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide ¼w, ½w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2-watt setting, the speaker shall provide a 90-dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480.

4. Speaker-Reentrant Surface

Provide 4-inch surface re-entrant speakers at the locations shown on the Drawings. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480. Weatherproof boxes shall be provided for out-door mounting.

5. Speaker-Strobes

Low Profile Speaker-Strobe

Provide low profile wall mount speaker/strobes at the locations shown on the Drawings. The low profile speaker/strobe shall not extend more than 1-inch (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1w (87dBA), ½w (84dBA), or ¼w (81dBA) at 10 feet when measured in reverberation room per UL-464.

Strobes shall provide synchronized flash output that shall be switch selectable for output values of 15cd, 30cd, 75cd and 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring. The low profile speaker/strobes shall mount in a North American 4-inches x 2½-inches square electrical box, without trims or extension rings.

6. Speaker-Strobe 4-inch

Provide 4-inches red speakers/strobes at the locations shown on the Drawings. Speakers shall have a 4-inches Mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide ¼w, ½w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2 watt setting, the speaker shall provide an 87 dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, and 110cd devices.

7. Speaker-Strobe Ceiling 8-inch

Provide 8-inches ceiling mounted speaker/strobes at the locations shown on the Drawings. In and out screw terminals shall be provided for wiring. Speaker baffles shall be round or square, steel with white finish as required. Provide square surface mount boxes with matching white finish as required. Speakers shall provide ½w, 1w, 2w, and 4w power taps for use with 25V or 70V systems. At the 4 watt setting, the speaker shall provide a 94 dBA sound output a frequency of 1000Hz when measured in an anechoic chamber at 10 feet. Strobes shall provide synchronized flash outputs. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 75cd, and 110cd devices.

8. Speaker-Strobe Re-entrant

Provide 4-inch red re-entrant speaker/strobes at the locations shown on the Drawings. Weatherproof boxes shall be provided for outdoor mounting. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable. At the 15-watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 75cd, and 110cd devices.

C. Visual Alarm Indicator

1. Lamp/Strobe internally illuminated projecting lens assembly, with flasher system. Unit shall flash on and off to provide visual indicating of fire alarm.
2. The word "fire" shall appear on the lens or lens plate.
3. Flash rate, one flash per second, with a flash duration of approximately 0.001 second, flash rate independent of audible device.
4. Light source, Xenon high intensity flash strobe tube white/clear color.
5. Strobe shall have a minimum output of 75 candelas with a maximum flash intensity of 120 candelas.
6. Strobe shall comply with NFPA Requirements.

2.07 REMOTE FIRE ALARM ANNUNCIATOR

A. General

1. The annunciator panel shall be powered and operated from the fire alarm control panel. "In-out" circuit conductors shall terminate on numbered screw-type terminals.
 2. A metal tamper resistant weatherproof cabinet shall contain the annunciator components. The panel shall be surface or flush mounted as indicated on the Drawings. Provide a full height tamper resistant, hinged locking cabinet door. Door shall have transparent high impact windows to allow visual observation of all indicators and switches.
 3. An electronic digital, multiplex, addressable module shall be incorporated into the annunciator. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
- B. Each Alarm Initiating Zone (including spares) shall be individually annunciated in the annunciator panel.
- C. A Common Fire Trouble Alarm shall be annunciated in the annunciator panel from the fire alarm control panel.
- D. Annunciator Lamp Circuits shall be automatically supervised. Provide lamp test switch in the annunciator panel.
- E. An Audible Alarm/Trouble Buzzer with silence switch and automatic resound for subsequent alarm/trouble signals shall be provided. The annunciator panel shall be automatically reset when the control panel is reset.
- F. A Keyed Switch shall be provided for remote reset of the system. The annunciation panel shall also be automatically reset when the control panel is reset.
- G. Provide a Floor Plan of the facility framed under acrylic and mounted adjacent to the fire alarm annunciator. The Floor Plan shall be to scale and shall have room numbers clearly displayed on all rooms corresponding to the annunciator for the purpose of easily identifying the fire zones.

2.08 REMOTE EQUIPMENT MONITORING AND CONTROL

- A. An Electronic Digital Multiplex addressable module shall be provided at each device or equipment indicated to be controlled by the multiplex system. Multiple addressable control ports shall be provided in each module quantity as required for each point controlled or monitored. The module shall communicate the monitor status control action and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
- B. Where multiple points are monitored or controlled, provide digital, multiplex, Multi-points, Monitor, Control Panel (MMCP). The panel cabinet shall be self-contained NEMA 1 construction and hinged locking door. Provide tamper switch detection zone on the cabinet door; provide 60 hour battery UPS backup and power supply, the same as required for the fire alarm control panel. Panel shall be expandable using plug-in circuit monitor/control printed circuit cards. Provide barriered numbered terminal strips.
- C. Each Control Point shall provide a supervised "dry" relay contact single pole double throw maintained contact rated 10-amp, 227 volt, 60Hz AC.
- D. Each monitor point shall provide not less than one of the following supervised methods of monitoring a remote device or equipment action or status.
 - 1. Remote "dry" contact operation normal open, normally closed or momentary contact operation.

PART 3 - EXECUTION

3.01 IDENTIFICATION

- A. The inside cover of alarm initiating devices shall be marked with the zone initiating number corresponding to the zone number in the control panel. Marking shall be with a felt-tip pen.
- B. Each fire alarm terminal cabinet shall be painted red.
- C. Provide nameplate: "Power to Main Fire Alarm Control Panel" screwed onto the branch circuit overcurrent device supplying power to the main fire alarm control panel.

3.02 WIRING

- A. Review the total system point-to-point wiring layout to assure that the correct number and type of wires and conduit sizes are installed.
- B. Final connections, testing, adjusting and calibration shall be made under the direct supervision of a Factory-Trained Technician of the System Supplier.
- C. All wiring shall be in conduit.
- D. All wiring in cabinets shall be neatly formed, laced and made up on bolt and nut terminal blocks. Tag all spare conductors. All conductors shall terminate on terminal strips with spade lugs, of adequate size for all incoming and outgoing conductors. The strips shall be labeled as to their use and wiring diagram shall be placed on the cabinet door showing connections of all related equipment to these strips.
- E. Wiring Requirements for shielding certain conductors shall be as recommended by the Manufacturer. Provide all conduit, raceways and conductors per Manufacturers recommendations and include all material and labor costs in the Contract price.

- F. The conductors used for digital, multiplex communication between the fire alarm control panel and external remote initiation devices, control points and annunciators, shall be twisted, shielded, multi-conductor cable, #16AWG copper minimum with a separate internal ground/drain conductor, UL listed for fire alarm system use. One spare pair of multiplex conductors shall be provided in all main and branch device/equipment connections for future system use. "Tees" and taps at any junction box location in the communication lines, shall be permitted by the system to additional devices without affecting proper system operation.
- G. Wire Size: Wire shall be sized to insure installed circuit voltage drop does not exceed 10% to all devices.

3.03 OUTLET BOXES

Device outlet boxes shall be flush mounted unless indicated otherwise on the Drawings. Provide extension rings to finish flush with finish surface. Where the Drawings indicate surface mounted devices, outlet boxes shall be cast metal with threaded hubs. Where the conduit entrances are not exposed for surface mounted devices, provide flush outlet box behind the device box, and omit the conduit hubs on the device box. Size device boxes and outlet boxes per Manufacturer's recommendation and as required by Code for wire fills.

3.04 SPECIAL INSTALLATION REQUIREMENTS

- A. Air duct smoke detectors shall be installed in the supply air ducts and return air ducts with an air flow of 2000 CFM or greater, coordinate with Mechanical Contractor. Sampling tube shall extend across entire duct width. Provide ¾-inch conduit with 2#12 to respective motor control device to automatically shut down the respective fan motor upon detection of smoke in the air duct. Installation shall be in compliance with CMC 606.8.
- B. Water flow switches shall be installed on each main fire sprinkler rise pipe, coordinate with the Fire Sprinkler Contractor.
- C. Tamper switches shall be installed on each main fire sprinkler shut-off valve, coordinate with the Fire Sprinkler Contractor.
- D. Equipment shall be weatherproof gasketed where installed in locations exterior to the building, or where indicated on the Drawings. Weatherproof equipment shall be tamper resistant.
- E. Provide clear vandal resistant protective cover for all audio-visual devices located in student restrooms and public hallways.
- F. Provide wire guard for ceiling mounted smoke and heat detectors located in student restrooms.
- G. Connect fire alarm control panel with security/intrusion control panel for monitoring by remote monitoring company.
- H. Connect fire alarm control panel with master clock system to turn off class passing schedule, with paging system to turn off system when fire alarm system in alarm condition.
- I. Conduit with fire alarm wiring shall be painted red.
- J. Fire alarm system shall be programmed per actual building and room designation. Submit printout for review.

3.05 TESTING

- A. The Entire Fire Alarm System shall be tested in the presence of the Local DSA Inspector and a Representative of the Manufacturer after the installation is complete.
 - 1. Individually activate each manual initiating station and verify correct alarm operation and control panel response.
 - 2. Individually test each automatic initiating device and verify correct alarm operation, control panel response and remote equipment operation.
 - 3. The communication loops and the notification alarm circuits shall be opened in at least two locations per building to check for the presence of correct supervisory circuitry.
- B. Test the battery back-up system by disconnecting the incoming normal power and allowing this alarm system to operate 24 hours on battery power. Sound the alarm system for 5-minutes at the end of 24 hours on battery power.
- C. Perform all electrical and mechanical tests required by the Equipment Manufacturer's certification form. Measure and adjust each automatic detection detector to the maximum stable sensitivity setting. Detector tests shall be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. An operational check-out test and report shall be performed. Submit six copies of test report results. The tests and report shall include, but not be limited to:
 - 1. A complete list of equipment installed and wired.
 - 2. Indication that all equipment is properly installed and functions and conforms with these Specifications.
 - 3. Test of individual zones as applicable.
 - 4. Serial numbers locations by zone and model number for each installed detector.
 - 5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
 - 6. Technician's name, certificate number and date.
 - 7. The completed manual and automatic monitoring and control system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test.
 - 8. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a 90-day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Contractor shall readjust or replace the equipment and detector(s) and begin another 90-day test period. As required by the Architect, the Contractor shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until the District has obtained beneficial use of the building under tests.
- D. After the testing has been completed to the satisfaction of CFC 904(a) – 904.2(f) the Inspectors, provide the NFPA certificate of compliance to the District, the Local Fire Official, the Architect and DSA.

- E. Upon the receipt of Certificate of Compliance, the Installer/Supplier shall supply the District with a written Operating, Testing and Maintenance Instructions, Point-To-Point As-Built Drawings and Equipment Specifications. Maintenance provisions, CFC 904(a) – 904.2(f).

3.06 INSTRUCTIONAL SESSIONS

Provide a 2-hour instructional sessions conducted by a Factory-Authorized Technician at the job site after completion of all tests to instruct District Personnel on the use of the system. The first session shall be videotaped and conducted prior to final acceptance of the Project. The second session shall be held within eleven months of final acceptance of the Project, when requested by the District.

END OF SECTION 28 46 20
022619/212220-SSB

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

- A. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all site clearing work as required and 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.
- B. Removal of surface debris; removal of paving and curbs; removal of trees, shrubs, and other plant life; topsoil excavation; and repair of damaged vegetation and/or irrigation systems/system components.
- C. Removal of concrete and bituminous surfacing.

1.02 RELATED SECTIONS

- A. Section 312000: Earthwork.

1.03 REFERENCE STANDARDS

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".

1.04 REGULATORY REQUIREMENTS

- A. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for the construction of the work. The Owner shall reimburse the contractor for all necessary permits or inspection fees by any legally constituted agency.
- B. Perform all work of this Section in strict accordance with applicable Government Codes and Regulations especially meeting all safety standards and requirements of CAL/OSHA, County of Los Angeles and the City of Compton. Provide additional measures, added materials and devices as may be needed as directed by the District Representative at no added cost to the District.

- C. Comply strictly to Rule 1404, South Coast Air Quality Management District.
- B. Coordinate clearing Work with utility companies.

PART 2 – PRODUCTS

- 2.01 Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 31 20 00 – Earthwork.
- A. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify a waste area for placing removed materials.

3.02 PROTECTION

- A. Protect existing structures and site improvements indicated to remain, from damage by approved methods and/or as authorized by the District Representative. Removal of all protections shall be when work of this Section is completed or when so authorized by the District Representative.
- B. Protect Existing Utilities indicated or made known to remain traversing the job-site and serving existing adjacent facilities.
- C. Protect Existing Trees and Shrubs indicated to remain by providing temporary surrounding fencing so located a sufficient distance away so that trees and shrubs will not be damaged by site-clearing operations.
 - 1. Protection Barrier: A protection barrier shall be installed around the shrubs or trees to be preserved. The barrier shall be constructed of a durable fencing material, such as plastic construction fencing, snow fence, or chain link. The barrier shall be placed at or beyond the drip line. "Drip line" as referred to herein means a line which may be drawn on the ground around the tree directly under its outermost branch tips and which identifies that location where rainwater tends to drip from the tree. Placement of barrier to be approved by District Representative (Grounds Supervisor). If barrier is placed inside the drip line, then 3/4 inch plywood must be placed over the root zone up to the drip line. The fencing shall be maintained in good repair throughout the duration of the project, and shall not be removed, relocated, or encroached upon without permission of the District Representative (Grounds Supervisor).

2. Storage of Materials: There shall be NO storage of materials or supplies of any kind within the area of the protection barriers. Concrete, cement, asphalt materials, block, stone, sand and soil shall not be placed within the drip line of the tree(s).
3. Fuel Storage: Fuel storage shall NOT be permitted within 150 feet of any tree to be preserved. Refueling, servicing and maintenance of equipment and machinery shall NOT be permitted within 150 feet of protected trees.
4. Vehicles/equipment: NO parking or driving of vehicles or storage of equipment shall be permitted within the drip line of any tree to be preserved.
5. Debris and Waste Materials: Debris and waste from construction or other activities shall NOT be permitted within protected areas. Wash down of Concrete, cement or asphalt handling equipment, in particular shall NOT be permitted within 150 feet of protected areas.
6. Grade Changes: Grade changes can be particularly damaging to trees. Any grade changes should be approved by the District Representative (Grounds Supervisor) before construction begins and precautions taken to mitigate potential injuries.
7. Damages: Any damages or injuries to the preserved trees (including pruning or cutting of such trees not in conformity with the International Society of Arboricultural Pruning Guidelines and ANSI A300 Pruning Standards) shall be reported immediately to the District Representative (Grounds Supervisor). Severed roots shall be pruned cleanly to healthy tissue, using proper pruning tools. Broken branches/limbs shall be pruned according to International Society of Arboricultural Pruning Guidelines and ANSI A300 Pruning Standards. In the event that any damage, injury, improper pruning or cutting of a protected tree is deemed to be so substantial as to require its replacement (such determination to be made in the sole discretion of the District Representative), Contractor shall replace such tree with the same species and variety of tree, up to a box size of 48 inches, or if no such replacement is available, with a substitute species or variety as determined in the sole discretion of the District Representative. Any replacement tree shall be approved in advance by the District Representative. The value of the tree to be replaced shall be determined by a Certified Arborist selected by Contractor from the District's approved list of Registered Consulting Arborists. To the extent that the value of the replaced tree as determined by the Certified Arborist exceeds the cost of the replacement tree, Contractor shall be liable to District for such difference in value in addition to all costs associated with replacement of the damaged tree.
8. Removal of Existing Tree or Shrub: Prior to removing or cutting any trees designated for removal, the contractor shall coordinate with the District's Ground Supervisor. In the event that Contractor, a Subcontractor,

Sub-Subcontractor, material supplier or anyone else performing the Work of the Contract willfully, negligently or mistakenly removes any tree or shrub not designated for removal, Contractor shall immediately report such removal to the District Representative (Grounds Supervisor). Contractor shall replace such tree with the same species and variety of tree, up to a box size of 48 inches, or if no such replacement is available, with a substitute species or variety as determined in the sole discretion of the District Representative. Any replacement tree shall be approved in advance by the District Representative. The value of the tree to be replaced shall be determined by a Certified Arborist selected by Contractor from the District's approved list of Registered Consulting Arborists. To the extent that the value of the replaced tree as determined by the Certified Arborist exceeds the cost of the replacement tree, Contractor shall be liable to District for such difference in value in addition to all costs associated with replacement of the damaged tree.

9. Unauthorized Tree Removal or Injury: Criminal Penalties: Reference is made to California Penal Code §384a which provides that any person who willfully or negligently cuts, destroys, mutilates or removes any tree or shrub or portion thereof growing on public land without a written permit from the owner of said public land is guilty of a misdemeanor, subject to a fine of up to \$1,000, imprisonment in county jail for up to 6 months, or both. Contractor is advised that, in addition to all remedies provided herein and in the Contract Documents, the District shall cooperate with appropriate authorities in prosecuting and enforcing Penal Code §384a and other criminal sanctions as appropriate concerning trees and shrubs located on District property.
 10. Preventive Measures: Before construction begins fertilization of the affected areas to be applied at a rate to be determined by the District Representative (Grounds Supervisor).
- D. Protect bench marks, survey control points, and existing structures from damage or displacement.
- E. Protection of Persons and Property (existing structures and site improvements):
1. Provide barricades, warning signs at open depressions and holes on adjacent property and public accesses.
 2. Provide operating warning lights during hours from dusk to dawn each day or as otherwise required.
 3. Protect existing remaining structures, utilities, sidewalks, pavements other facilities from damage as caused by settlement, undermining, washout or other hazards created by site-clearing operations of this Section.
- F. Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors and to others performing work on or near the job-site.

- G. Maintain access to the job-site at all times.

3.03 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove all rubbish and debris existing and resulting from work operations of this Section as soon as possible, do not allow to pile up. Do not burn rubbish and debris on the job-site.
- C. Where active utility lines need to be capped or plugged, perform such work in accordance with requirements of the Utility Company.

3.04 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Excavate and remove associated plumbing piping.
- C. Prior to demolition work, the Contractor shall notify the District Representative to identify the existing items for salvage purposes. The materials identified for salvage shall be returned to the District in a timely manner agreed upon by the District Representative.

3.05 CONCRETE AND BITUMINOUS SURFACE REMOVAL

- A. Where noted on the construction drawings, break up and completely remove all existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to limits indicated to be removed. All cutting shall be done to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1-1/2", unless otherwise specified. Remove any concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match the existing.
- B. Removed concrete and bituminous materials shall be disposed of off-site unless otherwise noted on the construction drawings. All such items to be removed shall be disposed of off the property in a legal manner.
- C. Bituminous pavement saw cutting shall conform to the provisions of Section 300-1.3.2 (a) of the Standard Specifications. The residue resulting from the saw cutting operations shall not be permitted to flow beyond the specific work location and shall be removed the same day.
- D. Removal of concrete curb / curb & gutter covered by this section shall include saw-cutting and removal of a twelve (12") inch wide section of the adjacent bituminous pavement.

- E. When saw cutting concrete curb / curb & gutter, the cuttings shall be continuously wet vacuumed to prevent the materials from entering catch basins, storm water conveyances, or waters of the State. Vacuumed cuttings shall be disposed of according to applicable regulations.
- F. Concrete curb and concrete curb and gutter shall be removed to the lines, grades and locations shown on the plans in accordance with Section 300-1.3.2 of the Standard Specifications.
- G. Concrete removal in sidewalk and driveway areas shall extend to existing score lines unless specifically indicated otherwise on the Plans or in the Project Special Provisions, or unless otherwise approved by the Engineer.
- H. Reinforcing or other steel may be encountered in portions of concrete to be removed. No additional compensation will be allowed for the removal of concrete containing reinforcing or other steel.
- I. In those areas where existing bituminous surfacing is removed to make way for new planting or lawn areas, remove soil 6" below existing exposed soil surface. Removed soil may be used only as fill under buildings or other areas to be paved, only if approved by the District Inspector. Legally dispose of off site, if material is not approved as fill material.

3.06 REPAIRS

- A. During demolition and construction, ensure that trees, shrubs and other plant material and vegetation are protected inside and outside of the work zone and that the vegetation is being watered, maintaining the proper moisture content according to the season. Failed vegetation, including sod, due to lack of water, and/or plant material destroyed during construction period are to be replaced to equal or better size and condition at no additional cost to the District.
- B. If the irrigation system is damaged or modified during construction, it shall be repaired to the Districts standards, and shall be in equal or better condition than prior to damage or modification. All repairs shall be, inspected and approved by the District Representative (Grounds Supervisor) prior to backfilling or covering of said repairs. The District representative requires forty-eight hours prior notice, when contractor requests inspection of completed repairs. All repairs shall be made so as to ensure proper operation prior to the close of the contract at no additional cost to the District.
- C. Controller Wires: If damaged, cut or removed, repair by splicing, soldering and silicone sealing. To ensure proper operation, reconnect the wires to the valve to correspond with the map on the controller to the correct station.
- D. Hydraulic Tubes: If damaged/cut or removed, repair by replacing the tubing using equal or better material.

- E. Valves: If damaged, repair/replace with equal or better material. All valves are to be flushed/cleaned thoroughly.
- F. Mainlines: If damaged, repair/replace with equal or better material. All lines are to be flushed/cleaned thoroughly.
- G. Lateral Lines: If damaged, repair/replace with equal or better material. All lines are to be flushed/cleaned thoroughly.
- H. Irrigation Heads: If damaged, repair/replace with equal or better material. All heads are to be flushed and filters cleaned thoroughly.
- I. Controllers: If damaged repair/replace with equal or better material.
- J. Backflow Prevention Devices: If damaged, repair/replace with equal or better material.
- K. Gate/Ball/Quick Coupler Valves: If damaged repair/replace with equal or better material.
- L. Valve Boxes: If damaged, repair/replace with equal or better material. Concrete boxes and concrete lids with the appropriate markings for identification shall be used. The top of the box shall be buried below finish grade, equal to existing depth or deeper. The top of the valve stems shall be 6" below the underside of the top of the box.
- M. Construction in grass areas: Sod shall be removed by sod cutting at a soil depth of 2", stored on site, and watered on a daily basis. Upon completion of work, stored sod shall be reinstalled over the areas disrupted due to construction. An option may be to bypass cutting the sod, however at the completion of the project, finish grading and installation of new Hybrid Bermuda GN -1 sod over the areas disrupted by construction shall be required.

3.07 EXCESS MATERIALS DISPOSAL

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

3.08 SITE CLEANUP

- A. Cleanup of branches, limbs, logs, or any other debris resulting from any operations shall be promptly and properly accomplished. The work area shall be kept safe at all times until all operations are completed. Under no circumstances shall the accumulation of brush, limbs, logs, or other debris be allowed in such a manner as to result in a hazard to the public. All debris shall be cleaned up each day before the work crew leaves the site, unless permission is given by the Owner to do otherwise. All lawn areas shall be raked, all streets and sidewalks shall be swept, and all brush, branches, rocks or other

debris shall be removed from the site. Areas are to be left in a condition equal to or better than that which existed prior to the commencement of operations.

END OF SECTION

**SECTION 31 20 00
EARTHWORK**

PART 1 - GENERAL

1.01 SUMMARY

- A. The work of this section shall include excavation, unclassified cut, unclassified fill, removing existing unsatisfactory material, preparing areas to be filled, spreading and compacting of fill in the areas to be filled, and all other work necessary to complete the grading of the site. It shall be the Contractor's responsibility to place, spread, moisten or dry, and compact the fill in strict accordance with these specifications to the lines and grades indicated on project plans or as directed in writing by the Geotechnical Engineer. Included with this Work are the following:
1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and hillsides.
 2. Excavating, filling, backfilling, and compacting for Project site pavement, planting areas, buildings, and other structures.
 3. Subgrade preparation for hardscape.
 4. Excavating and backfilling trenches.
 5. Shoring plan guidelines.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
1. Section 31 31 32 - Import Materials Testing.
 2. Section 31 71 23 – Field Engineering.
 3. Section 32 12 16 - Asphalt Paving.
 4. Section 32 13 13 - Cement Concrete Pavement.
 5. Owner provided Geotechnical Report.

1.02 DEFINITIONS

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off site when sufficient approved soil material is not available from excavations.

- D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- E. Drainage Fill: Course of washed granular material supporting slab on grade placed to cut off upward capillary flow of pore water.
- F. Permeable Backfill: Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations.
- G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below ground surface.
- I. Utilities include underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.03 SUBMITTALS TO CONSTRUCTION MANAGER

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Imported Soils: CONTRACTOR shall provide the services of a licensed environmental professional (licensed State of California Professional Engineer [PE Civil], Registered Geologist [RG] or Registered Environmental Assessor II [REA II]) familiar with environmental site assessment and waste classification and disposal requirements. The CONTRACTOR shall provide an independent approved California Department of Health Services certified testing laboratory, to perform sampling and testing of imported fill materials in accordance with the terms as specified in Section 31 31 32: Import Materials Testing.
 - 1. Testing laboratory must be pre-approved by the Division of State Architect.
- C. Product data for the following:
 - 1. Each type of plastic warning tape.
 - 2. Filter fabric.
- D. Samples of the following:
 - 1. 12 by 12 inch sample of filter fabric.
- E. Test Reports: In addition to test reports required under field quality control, submit the following:
 - 1. One optimum moisture-maximum density curve for each soil sample.

2. Laboratory analysis of each soil material proposed for fill or backfill from borrow sources.
- F. Excavation support & protection (shoring) shop drawings for informational purposes: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1.04 QUALITY ASSURANCE

- A. Codes and Standards:
1. 2016 California Building Code, Title 24, Part 2, Volume 2 of 2, Appendix J, Grading.
 2. ASTM D422 - Method for Particle Size Analysis of Soils
 3. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
 4. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 kg) and 18-inch (457-mm) Drop.
 5. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
 6. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
 7. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
 8. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 9. AASHTO T217 - Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Meter.
 10. ASTM D4829 - Expansion Index Test.
- B. Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".
- C. Sampling, testing, and certification of imported soils shall be performed in accordance with Section 31 31 32 - Import Materials Testing.
- D. Comply with all requirements of permit for export of soil from site. Permit is to be obtained and paid for by Contractor. Furnish copies of all permits and licenses required by the City of Compton to Owner's representative.

- E. Professional Observation: A soils engineer will be retained by the Owner for purposes of inspection, testing and approval of all work under this section. Perform work of this Section under inspection and approval of the soils engineer. Give soils engineer not less than 48 hours advance notice of readiness for inspection.
- F. The soils engineer will have the authority over all filling, grading, and compaction operations, including interruption of work if deemed necessary due to improper work
- G. Pre-Grading Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. Before commencing earthwork operations, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.05 CONSTRUCTION MONITORING

- A. All earthwork and foundation construction should be monitored by a qualified engineer/technician under the supervision of a Geotechnical Engineer, including;
 - 1. Observation of all site preparations;
 - 2. Observation of shoring installation, if needed;
 - 3. Observation of all site excavations;
 - 4. Test and approval of all import soil;
 - 5. Observation of placement of all compacted fills and backfills;
 - 6. Observation of all surface and subsurface drainage systems;
 - 7. Observation of all foundation and pile excavations;
 - 8. Observation of subgrade preparation for paved and building areas.
- B. The Geotechnical Engineer of Record should be notified at least three (3) days in advance of the start of construction. A joint meeting between the Contractor and Geotechnical Engineer is recommended prior to the start of construction to discuss specific procedures and scheduling. The Geotechnical Engineer should be present to observe the soil conditions encountered during construction, to evaluate the applicability of the recommendations presented in the Soils Report to the soil conditions encountered, and to recommend appropriate changes in design or construction if conditions differ from those described herein. The Geotechnical Engineer of Record should inspect and approval all imported backfill material prior to its placement as backfill, approve the subgrade beneath all fills, fill placement and bottom of all foundation excavations before concrete or steel is placed.

- C. The Geotechnical Engineer shall submit compaction reports to the Construction Manager and the Civil Engineer at the completion of the work, including test results and plot plans indicating the locations from which the tested samples of fill were taken. The Geotechnical Engineer shall keep the Construction Manager informed on the progress of the grading work.

1.06 IMPORT AND EXPORT OF EARTH MATERIALS

- A. Fees: Pay as required by government authority having jurisdiction over the area.
- B. Bonds: Post as required by government authority having jurisdiction over the area.
- C. Hauling Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.07 TRUCK HAUL ROUTE

- A. A proposed truck haul route is to be submitted to the City of Compton Public Works for review and approval. Upon approval, an approved copy shall be returned to the Contractor. The Contractor shall post an approved copy on the job site. All trucks working that project shall also carry a copy. If a truck(s) is found not to be carrying an approved copy, the Contractor shall be subject to a Notice of Noncompliance (stop work order)
- B. All trucks must cover their dirt with an acceptable tarp during transport for dust containment. Provisions for street sweeping and watering will also be required unless an active wheel washing facility proves that they are un-necessary to the satisfaction of the Engineer.
- C. All truck haul routes, as approved, are good only for the project time period, and trucks shall have to comply with the approved route only. If during the progress of the project an alternate route is needed, the Contractor shall submit a new plan. The haul route application shall contain the following information:
 - 1. Map showing the proposed route
 - 2. Project name
 - 3. Grading Contractor's name, address and phone number
 - 4. Type of material being hauled
 - 5. Encroachment or construction permit number

1.08 DIG ALERT NOTIFICATION

- A. Before any excavation in or near the public right-of-way, the Contractor must 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 you to hand expose to the point of no conflict 24" (inches) on either side of the underground facility, so you know its exact location before using power equipment.
- F. If caught digging without a Dig Alert ticket you can be fined as much as \$50,000 per California government code 4216.

1.09 SUBSURFACE CONDITIONS

- A. Where investigations of subsurface conditions have been made by the Owner with respect to subsurface conditions, utilities, foundation, or other structural designs, and that information is shown in the Plans, it represents only a statement by the Owner as to the character of materials which have actually been encountered by the Owner's investigation. This information is only included for the convenience of Bidders.
- B. Investigations of subsurface conditions are made for the purpose of design only. The Owner assumes no responsibility with respect to the sufficiency or accuracy of borings or of the log of test borings or other preliminary investigations or of the interpretation thereof. There is no guaranty, either expressed or implied, that the conditions indicated are representative of those existing throughout the Work, or any part of it, or that unanticipated conditions may not occur. When a log of test borings is included in the Plans, it is expressly understood and agreed that said log of test borings does not constitute a part of the Contract. The log of test borings represents only an opinion of the Owner as to the character of the materials to be encountered, and is included in the Plans only for the convenience of the Bidders. Making information available to Bidders is not to be construed in any way as a waiver of the provisions of the first paragraph of this Section, and Bidders must satisfy themselves through their own investigations as to conditions to be encountered

1.10 PROJECT CONDITIONS

- A. Data: Maps, boring logs, geotechnical and foundation investigation reports, and like reference data, not included in Contract Documents but made available to Contractor by Architect or Owner are for information only, and the Architect and Owner assume no responsibility for any conclusions Contractor may draw from such information. Should questions or issues arise, contact Architect or Owner for clarification.
- B. Contractor shall determine existing conditions under which the Contractor will operate in performing the Work

- C. A geotechnical investigation report no. 10-18469PW has been prepared by United-Heider Inspection Group, dated November 18, 2018 and a supplemental report dated November 2, 2018, for this project. Prior to bidding or performing the work of this project, contractor shall obtain a copy of this report, and shall thoroughly familiarize himself/herself with its contents. Any information obtained from such report, or any information given on any drawings as to subsurface soil conditions or to elevations of existing elevations or elevations of underlying rock, is approximate only, is not guaranteed, and does not form a part of the contract, unless specifically referenced in the Contract Documents. The Contractor is required to make a visual inspection of the Project Premises and must (and is permitted to) make whatever tests the Contractor deems appropriate to determine and assess the underground condition of the soil. No claims for allowances or damages because of the Contractor's negligence or failure in acquainting itself with the conditions of the Project Premises as described herein will be recognized by the Owner.
- D. WARNING: OWNER DOES NOT WARRANT THE SOILS AT THE PROJECT SITE. SOILS INVESTIGATION REPORT IS PROVIDED FOR CONTRACTORS INFORMATION ONLY. CONTRACTOR HAS CONDUCTED AN INDEPENDENT INVESTIGATION OF THE PROJECT SITE AND THE SOILS CONDITIONS OF THE SITE. OWNER DOES NOT WARRANT THE SOILS CONDITIONS OF THE SITE AND CONTRACTOR IS FULLY RESPONSIBLE TO ASCERTAIN SITE CONDITIONS FOR THE PURPOSES OF DETERMINING CONSTRUCTION MEANS AND METHODS PRIOR TO COMMENCING CONSTRUCTION. THE SOILS INVESTIGATION REPORT IS NOT A CONTRACT DOCUMENT.
- E. Information on Drawings does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.
- F. Existing utilities: Locate existing underground utilities in all areas of work prior to excavation or commencement of work. If utilities are to remain in place provide adequate means of protection during earthwork operations.
1. Should uncharted, or incorrectly charted piping or other utilities be encountered during excavation, consult Utility Owner immediately for direction. Cooperate with Owner and Utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of Utility Company.
 2. Do not interrupt existing utilities serving facilities occupied or used by Owner, or others, except when permitted in writing by Owner's Representative, and then only after acceptable temporary services have been provided.
 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut off of services if lines are active.
- G. Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances.
- H. Water for Grading: Contractor shall obtain and pay for all water required for his grading operation. This may include, but is not limited to, payment of deposits to utility for

construction meter, and payment of all monthly service and water charges. Construction meter shall be in place throughout construction period unless alternative arrangements are made with the City of Compton Water Department to provide construction water for all purposes. Contractor shall be aware of water moratoriums and restrictions, and shall immediately advise Owner of effects on construction schedules.

- I. Existing Conditions: Prior to commencing work at site, verify agreement of existing conditions with indicated conditions. Notify Owner's Representative in writing of discrepancies found. Start of work without notification constitutes acceptance of conditions, without cause for extra compensation.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: All soils materials to be used throughout the site shall be approved for use by the Geotechnical testing engineer. Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. No earthwork analysis has been completed with respect to the volumes of soils to be excavated, placed, or imported in order to provide the finished grades shown on the plans. The Contractor is solely responsible for verifying the earthwork quantities necessary to complete the project.
- C. For earthwork volume estimating purposes, an average shrinkage volume of 5 to 10 percent and subsidence of 0.1 foot may be assumed for the surficial soils. These values are estimates only and exclude losses due to removal of vegetation and debris. Actual shrinkage and subsidence will depend on the types of earthmoving equipment used and should be determined during rough grading.
- D. Satisfactory Soil Materials: Soils approved by the testing geotechnical engineer and free of rock or gravel larger than 3 inches in any dimension, debris, waste, vegetation and other deleterious matter and as approved by the Geotechnical Engineer. Rocks or hard lumps larger than approximately 3 inches in diameter should be broken into smaller pieces or should be removed from the site. The on-site shallow silty sand is considered non expansive and is suitable for backfilling purposes.
- E. Borrow / Imported Fill Material: Soil excavated from site or imported conforming to requirements for fill material.
 1. Materials for the fill shall be free from vegetable matter and other deleterious substances, shall not contain rocks or lumps of a greater dimension than is recommended by the geotechnical consultant, and shall be approved by the geotechnical consultant.
 2. Soils proposed for import shall be tested pursuant to the requirements of Section 31 31 32: Import Materials Testing, unless a variance has been requested by CONTRACTOR and approved by the OAR prior to the import of the subject materials.

3. Import materials have an expansion index (EI) of less than 21 and should contain sufficient fines (binder material) so as to be relatively impermeable and result in a stable subgrade when compacted. Import soils should be tested and approved by the Geotechnical Consultant prior to importing.
- F. Base Course Material For Use Under Asphalt Pavement: Crushed base material shall consist of materials that meet the provisions listed below.
1. Crushed Aggregate Base (CAB) per Section 200-2.2, 3/4" maximum of the Standard Specifications for Public Works Construction (Green Book).
 2. Crushed aggregate base (CAB) shall consist of native rock without naturally occurring asbestos or recycled materials. The Contractor shall submit written documentation, which identifies the source, volume, and proposed transport date of the material for review and approval by the Owner's Construction Manager prior to importing the material. A statement on company letterhead from the source, stamped by either a California Professional Geologist or Engineer, which states that the subject materials are native rock, do not contain any recycled materials and that the source does not mine ultramafic materials, a source of natural occurring asbestos shall be included in the submittal to Owner's Construction Manager.
 3. Crushed Miscellaneous Base (CMB) per Section 200-2.4, fine sieve, of the Standard Specifications for Public Works Construction (Green Book).
- G. Engineered Fill: Satisfactory Soil Materials / Borrow Fill Material, as described above, placed in lifts no greater than 8 inches thick (loose measurements), and compacted to the requirements noted in the project soils report.
- H. Bedding Material for Trenches:
1. Bedding sand shall be as defined by Standard Specifications, Section 200-1.5, and shall be free of expansive material and organic matter. On-site soils are not considered suitable for bedding of utilities.
 2. Sand providing a sand equivalent of at least 30. All of the sand bedding shall be compacted as indicated in the Contract Documents by mechanical means. Flooding and jetting shall not be permitted without prior written approval from the Geotechnical Engineer. Where sheeting or shoring is used densification of the bedding shall be accomplished after the sheeting or shoring has been removed from the bedding zone, unless the sheeting or shoring is to be cut off or left in place. Pipe bedding material shall be placed in horizontal layers not exceeding (8) eight inches.
- I. Backfill Material for Trenches:
1. The on-site soils have been determined to be suitable for being used for backfilling purposes in trenches. Utility trenches should be backfilled with granular materials and mechanically compacted to at least 85% of the maximum dry density of the soils in softscape areas.

2. Below hardscape, a minimum relative compaction of 90% is required in the subgrade.
- J. Filter Fabric: Manufacturer's standard nonwoven geotextile fabric of polypropylene geotextiles, "Mirafi 140N" or approved equal.

2.02 ACCESSORIES

- A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film metallic warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Red: Fire Water & Electric.
 - b. Yellow: Gas, oil, steam, and dangerous materials.
 - c. Orange: Telephone and other communications.
 - d. Blue: Potable Water systems, with "Caution: Water Line Below."
 - e. Green: Sewer systems, with "Caution: Sewer Line Below."
 - f. Green: Storm systems, with "Caution; Storm Drain Line Below."

2.03 EXCAVATION SUPPORT & PROTECTION – SHORING PLAN

- A. The CONTRACTOR shall have at the Worksite, copies or suitable extracts of: Construction Safety Orders, Tunnel Safety Orders and General Industry Safety Orders issued by the State Division of Industrial Safety. The CONTRACTOR shall comply with provisions of these and all other applicable laws, ordinances, and regulations.
- B. Before excavating any trench 5 feet or more in depth, the CONTRACTOR shall submit a detailed plan to the Owner showing the design of shoring, bracing, sloping, or other revisions to be made for the Workers' protection from the hazard of caving ground during the excavation of such trench. If the plan varies from the shoring system standards, the plan shall be prepared by a registered Civil Engineer. No excavation shall start until the DISTRICT has accepted the plan and the CONTRACTOR has obtained a permit from the State Division of Industrial Safety. A copy of the permit shall be submitted to the DISTRICT.
- C. The INSPECTOR will provide a competent person trench/excavation certification form to the CONTRACTOR. It shall be completely filled out before any worker has access to trench or excavation and returned to the INSPECTOR before the end of the first working day. The CONTRACTOR shall certify by this form the name of the competent person administering the Work, the soil classification, and the type of excavation protective system provided and/or installed.

- D. The CONTRACTOR shall completely fence all excavations to provided protection against anyone falling into the excavation and to the satisfaction of the INSPECTOR. The fencing shall be in place at all times except when workers are present and actual construction operations are in progress.
- E. The fencing material shall be chain link fabric or welded wire fabric and 6 feet high, constructed according to one of the following:
 - 1. Tensioned fencing material and have top and bottom tension wires securely fastened to driven steel posts or other equally rigid elements at a maximum spacing of 12 feet; or
 - 2. Untensioned fencing materials securely fastened to extended trench shoring elements at a maximum spacing of 8 feet and fastened to continuous top and bottom rails constructed of nominal 2 in x 4 in lumber or equally rigid material. Framed panels with suitable supporting elements fastened together to form a continuous fence may also be used.
- F. Payment for performing all work necessary to provide safety measures shall be included in the prices bid for other items of work except where separate bid items for excavation safety are provided, or required by law.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect adjacent property and existing improvements and structures as necessary to prevent undermining, caving of cuts, and miscellaneous damage.
- B. Provide cribbing, sheeting, and shoring necessary to safely retain the earth banks and protect excavations and adjoining grades from caving and other damage resulting from excavating together with suitable forms of protection against bodily injury to personnel employed on the work and the general public. Be responsible for the design, installation, and maintenance of required cribbing and shoring and shall meet the approval of the State Division of Industrial Safety and local governing agencies requirements.
- C. Utility lines and structures shown shall be protected and treated as indicated. Where work not shown is encountered, report it to the Architect before proceeding with excavation. Encase active lines in sleeves where they pass through concrete; remove inactive lines as directed, and plug the remaining ends. Bear the costs for repairs to damaged or broken utilities and any damages related thereto.
- D. Protect existing improvements and adjacent properties from storm damage and flood hazard originating on this project until final acceptance by the Owner. Prevent silt run-off from the limits of work in accordance with governmental requirements.
- E. A minimum 6-foot high, temporary chain link fence and gates, (pair 26' wide, minimum) shall be erected prior to any grading operations at the construction limits perimeter. Coordinate the exact location with Architect and Inspector.

3.02 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Any water entering an excavation shall be immediately pumped out and the exposed excavation allowed to dry.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.03 GRADE STAKES

- A. The Contractor's Surveyor will set grade stakes. The Surveyor shall be a California registered land surveyor or licensed Civil Engineer. The Surveyor shall be hired and paid by the Contractor, and shall be subject to the approval of the District. Contractor shall notify the District at least 48 hours before staking is to be started. The District will determine if work is ready for staking.
- B. All work shall conform to the lines, elevations, and grades shown on the Construction Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.
- C. Protect and maintain stakes in place until their removal is approved by the District. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.
- D. Grades for underground conduits will be set at the surface of the ground. The Contractor shall transfer them to the bottom of the trench.

3.04 EXCAVATION

- A. Excavation shall conform to the project soils report.
- B. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork", except as modified herein.
- C. In preparation for grading, the construction areas should be cleared of surface vegetation, concrete, pavement and any loose surficial soils. Any unsuitable material encountered should be properly disposed of and not incorporated into any new fill.
- D. Excavate to the depths, lines and grades indicated on the approved Grading Plan. Excavate sufficiently over-size to permit installation and removal of concrete forms and other required work. Should soil of inadequate density and bearing capability be encountered at the elevations indicated on the drawings, or where new fill is to be placed upon existing loose fill material exposed by excavation, the excavation shall be carried to the depth required to attain soil of bearing quality as determined by the Geotechnical Engineer.

- E. A California Licensed Surveyor (LS) must provide grade stakes and elevations for the Geotechnical Engineer to verify that the over-excavation depths, shown on the construction drawings for asphalt concrete pavement and concrete pavement structural sections, have been achieved prior to re-compaction.
- F. Should footing excavations exceed required dimensions or should sloughing occur, fill such extra space with concrete at no additional cost to the contract. If unsuitable material is found at the indicated depths, immediately notify the Inspector.
- G. Notify the Inspector 48 hours before foundation excavations are ready for inspection.
- H. The bottoms of footings shall be free of loose material, debris, and water before concrete is placed.
- I. Cut banks shall be neatly trimmed to the required finish surface as the cut progresses, or the Contractor shall have the option of leaving the cuts full and finish grading by mechanical equipment which shall produce the finish surfaces as shown on the Drawings.
- J. Surplus earth not needed for filling and grading shall be disposed of in a legal manner off the site.
- K. All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1970, and the Construction Safety Act should also be followed.
- L. Bills of lading or equivalent documentation will be submitted to the IOR on a daily basis.
- M. Upon completion of import operations, provide the OAR a certification statement attesting that all imported material has been obtained from the identified source site.

3.05 HAZARDOUS MATERIALS

- A. See Section 31 31 32: Import Materials Testing.
- B. All import fill material shall be characterized, handled, and documented in accordance with applicable US EPA and State of California hazardous waste and hazardous materials regulations.
- C. "Contaminated" shall mean any soil or geotechnical material at a concentration, which would require disposal at a regulated facility (i.e., California hazardous or RCRA hazardous).
- D. Owner's Authorized Representative (OAR) must be notified at least 72 hours prior to the disposal of any hazardous waste or hazardous material. No material disposal or reuse can take place without prior written approval of the OAR.
- E. Replacement of earth material, that has been removed due to hazardous waste reasons, shall be placed back to meet the requirements of Section 2.01, G – Engineered Fill.

3.06 EXCAVATION FOR BUILDING

- A. Refer to section 4.1.2 of the soils report for requirements.
- B. The maximum allowable slope of excavation shall not be steeper than 1H:1V. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. If the excavation is within 10 ft from surcharge loads from adjacent structures, contractor should notify the geotechnical engineer of record to evaluate the situation and provide appropriate recommendation. A competent person should daily observe the sloped excavation for any distress and notify the geotechnical engineer of record when distress is observed. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

3.07 EXCAVATION FOR FREE STANDING MASONRY SITE WALLS AND CONCRETE BENCHES & LOW WALLS

- A. The soil underneath brick masonry site wall footings shall be overexcavated and recompacted to a minimum depth of 12 inches below the bottom of the proposed footings or to a sufficient depth to remove all of the undocumented fill materials in their entirety from within the proposed site masonry wall footing area.

3.08 EXCAVATION, BACKFILL & COMPACTION FOR UTILITIES

- A. Field conditions may require deviations from information indicated on Drawings. Such changes in work shall be covered by a Change Order, indicating an increase or decrease in the Contract sum.
- B. Before excavation, Contractor shall contact the "Underground Service Alert of Southern California" (USASC) for information on buried utilities and pipelines.
- C. When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose, the existing improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before connection is made. Any adjustments in line or grade which may be necessary to accomplish the intent of the plans will be made, and the Contractor will be paid for any additional work resulting from such change in line or grade.
- D. Trenches, ditches, pits, sumps, and similar items which are outside the barricaded working area shall be barricaded to conform to Cal OSHA standards.
- E. Trenches over 5'-0" in depth shall conform to the Construction Safety Orders of the California Division of Industrial Safety, see Section 2.3 EXCAVATION SUPPORT & PROTECTION – SHORING PLAN.
- F. Safe and suitable ladders which project 2 feet above the top of the trench shall be provided for all trenches over 4 feet in depth. One ladder shall be provided for each 50 feet of open trench, or fraction thereof, and be so located that workers in the trench need not move more than 25 feet to a ladder.

- G. Where indicated and/or required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- H. All trenches should be backfilled with approved fill material compacted to relative compaction of not less than 90 percent of maximum density determined in accordance with ASTM D 1557. Backfill shall be placed in layers not exceeding 8" (inches) in thickness.
- I. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.
- J. Do not excavate trenches parallel to footings closer than 18" from the face of the footing or below a plane having a downward slope of 2 horizontal to one vertical, from a line 9" above bottom of footings.
- K. If soft, spongy, unstable, or other unsuitable material is encountered upon which the bedding material or pipe is to be placed, this material shall be removed to a depth ordered by the Engineer and replaced with bedding material suitably densified. Additional bedding so ordered, over the amount required by the Plans or Specifications, will be paid for as provided in the Bid. If the necessity for such additional bedding material has been caused by an act of failure on the part of the Contractor or is required for control of groundwater, the Contractor shall bear the expense of the additional excavation and bedding.
- L. Unless indicated otherwise on the plans are within this specification, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Maximum allowances at the sides for trenching shall be 12 inches. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.
- M. Where portions of existing structures, walks, paving, etc. must be removed or cut for pipe or conduit installation, replace the material with equal quality, finished to match adjacent work.
- N. Provide a minimum clear dimension of 6 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and/or tanks.
- O. **DO NOT** place backfill until the bedding and pipe work installed has been inspected, tested and approved by the Inspector. Remove excavated rocky material unsuitable for backfill from the site prior to final backfilling.

- P. Bedding material immediately around a utility line and to a point 12 inches above the line should consist of sand, fine-grained gravel, or cement slurry to support the line and protect it.
- Q. Bedding zone shall be defined as the area containing the material specified that is supporting, surrounding, and extending to 12" (inches) above the top of pipe.
- R. Bedding material shall first be placed on a firm and unyielding subgrade so that the pipe is supported for the full length of the barrel. There shall be 6" (inch) minimum of bedding below the pipe barrel and 1" (inch) clearance below a projecting bell for sewer, storm drain and water pipe. The material in the bedding zone shall be placed and densified by mechanical compaction only.
- S. Mechanically compacted backfill shall comply with section 306-1.3.2 of the Standard Specifications for Public Works Construction.
- T. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.
- U. Fill voids with approved backfill materials as shoring bracing and sheeting is removed.

3.09 INSPECTION & TESTING AT TRENCHES

- A. Pipe will be inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection. Any corrective work shall be approved by the Engineer and shall be at NO cost to the Owner.
- B. The Inspector or Geotechnical Engineer will inspect all subgrades and excavations prior to placing bedding & backfill materials.
- C. **DO NOT** place backfill until the bedding and pipe work installed has been inspected, tested and approved by the Inspector. Remove excavated rocky material unsuitable for backfill from the site prior to final backfilling.
- D. Utility backfill compaction test shall be performed in accordance with ASTM D1557, method "C".
- E. Utility backfill in place density test per ASTM D 1556 (sand cone) or other test method as considered appropriate by the Geotechnical Engineer.
- F. Hydrostatic pressure tests shall be done only after backfill has been placed and final compaction has been achieved.

3.10 APPROVAL OF SUBGRADE

- A. Notify Geotechnical Engineer when excavations have reached required over-excavation subgrade.
- B. When Geotechnical Engineer determines that unforeseen unsatisfactory soil is present, continue work only after receiving direction from the Contracting Officer.

- C. Reconstruct subgrades damaged by rain, accumulated water or construction activities as directed by the Soils Engineer.

3.11 UNAUTHORIZED EXCAVATION

- A. Fill of unauthorized excavation below bottoms of foundations or wall footings will be engineered fill.
- B. Fill unauthorized excavations under other construction as directed by the Soils Engineer.
- C. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Geotechnical Engineer.

3.12 STORAGE OF SOIL MATERIALS

- A. After the site has been stripped of all debris, vegetation and organic materials, excavated on site soils may be reused as engineered fill provided they meet the satisfactory soils material conditions in Section 2.01, part D. High in-site moisture contents will require aeration prior to placement as engineered fill.
- B. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees. Cover to prevent wind-blown dust.

3.13 PLACEMENT OF ENGINEERED FILL

- A. Preparation of the bottom of the excavation:
 - 1. Where structural foundations, slab on grade construction, asphalt pavement and concrete flatwork engineered fill is to be placed, the upper 6" (inches) of native soil must be scarified, moisture conditioned, and re-compacted to a minimum of 90 percent of the maximum dry unit weight as determined by the ASTM Test Method D1557.
- B. Spreading and Compacting Fill Material:
 - 1. All fills shall be placed in lifts no greater than 6 inches thick (loose measurements), and should be re-compacted to a minimum of 90 percent of the maximum dry unit weight as determined by the ASTM Test Method D1557.
 - 2. After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepsfoot rollers; vibratory rollers; multiple-wheel, pneumatic-tired rollers; or other types of acceptable compacting equipment. Equipment shall be of such design that it will be able to compact the fill to the specified density. Compaction shall be continuous over the entire area, and the equipment shall make sufficient passes to obtain the desired density uniformly. Jetting, puddling and hydroconcolitation techniques shall not be used.

3. When backfilling and compacting behind retaining walls and flexible retaining structures, the Contractor shall use lightweight compaction equipment such as hand-operated equipment, shoring, or other means to avoid over-stressing structural walls. When using lightweight compaction equipment, the fill materials shall be spread in horizontal layers not greater than 6 inches thick, measured before compaction.

C. Compaction Testing:

1. The Geotechnical Engineer's representative shall observe the excavation, filling, and compacting operations and shall make density tests in the fill material so that he can state his opinion as to whether or not the fill was constructed in accordance with the specifications. If the surface is disturbed, the density tests shall be made in the compacted materials below the disturbed zone. When these tests indicate that the density or moisture content of any layer of fill or portion thereof does not meet the specified density or moisture content, the particular layer or portions shall be reworked until the specified density and moisture content have been obtained.
2. Sampling and testing of materials for determination of compliance with the specified compaction requirements will be conducted by the Geotechnical Engineer's representative at any location and time as the Owner may determine.
3. The Contractor shall be responsible for excavation of the test pits and for providing and installing any shoring, ladders, or other equipment necessary to protect the testing personnel. The Contractor shall also suspend operations as necessary and at no cost to the owner for the purpose of conducting such testing.
4. Test pits shall be excavated in the backfill by the Contractor as directed by the Engineer for the purpose of testing the backfill compaction. At the option of Engineer, density tests may be taken on a lift of compacted backfill immediately before placing the next lift.
5. Any settlement noted in backfill, fill, or in structures built over the backfill or fill within the one-year warranty period will be considered to be caused by improper compaction methods and shall be corrected at the Contractor's expense. Structures damaged by settlement shall be restored to their original condition by the Contractor at the Contractor's expense.
6. When initial compaction testing performed by the Engineer indicates the required density has not been obtained, the Contractor shall re-compact or replace the backfill as necessary to meet the specified minimum density.
7. The Contractor shall be responsible for rescheduling compaction testing with the Engineer and shall bear all costs for subsequent retesting in the areas of noncompliance. Costs associated with retesting and scheduling delays shall be the sole responsibility of the Contractor. The Engineer will deduct the costs for testing of materials and work found to be unacceptable, as determined by the

tests performed by the Owner and the costs for testing of material sources identified by the Contractor which are not used for the work, from moneys due or to become due to the Contractor. The amount deducted will be determined by the Engineer.

3.14 BACKFILL - GENERAL

- A. Backfill excavations promptly, but not before completing the following:
1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.
 3. Testing, inspecting, and approval of underground utilities.
 4. Concrete formwork removal.
 5. Removal of trash and debris from excavation.
 6. Removal of temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.15 GRADING

- A. Rough & Fine Grading: Rough grade area sufficiently high to require cutting by fine grading.
- B. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between existing adjacent grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
 3. Grade area for paving to a depth below finish grades indicated, equal to base and pavement thickness to be constructed.
 4. Cut banks neatly to required finish grades as cut progresses, or leave cuts full and finish grading by mechanical equipment, which will produce finish grades indicated on Drawings.
 5. Grade filled banks full and compact beyond grade of finish bank so that when trimmed to finish grades, soil is compacted to density specified for final slope face.
 6. Bring areas to be graded to approximate finish grades and then scarify, moisten and roll to obtain required density. Scarify, moisten and roll resulting high and low areas to obtain required finish grades by cutting and filling.
 7. Grade future planting areas so that, upon cultivation and fertilization, they will conform to finish grades indicated for planting areas.

8. Protect all utilities.
- C. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Building pad tolerance plus or minus ½ inch (0.05-foot).
 2. Lawn or Unpaved Areas: Plus or minus (0.10-foot).
 3. Walks: Plus or minus (0.04-foot).
 4. Pavements: Plus or minus (0.04-foot).
- D. Grading Inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested with a 10-foot straightedge.

3.16 FIELD QUALITY CONTROL

- A. The CONTRACTOR shall provide an independent approved California Department of Health Services certified testing laboratory, to perform sampling and testing of import/export fill materials in accordance with the terms as specified in Section 31 31 32: Import Materials Testing.
- B. A Geotechnical Engineer, designated by the Owner, will be engaged to perform continuous inspection of the placing and compacting of all fills and backfills within the limits of grading of this project. All work shall be done in accordance with the approved plans and these specifications and as recommended and approved by the Geotechnical Engineer. Revised recommendations relating to conditions differing from the approved soils engineering and engineering geology reports shall be submitted to the owner, inspector, architect and the civil engineer. Costs for all such inspections and tests shall be paid by the Owner. The Contractor shall be responsible for notifying the Geotechnical Engineer in advance so that he may be present to perform his services as needed.
- C. The Geotechnical Engineer shall submit compaction reports to the Construction Manager and the Architect at the completion of the work, including test results and plot plans indicating the locations from which the tested samples of fill were taken. The Geotechnical Engineer shall keep the Construction Manager informed on the progress of the grading work.
- D. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
1. Perform field in-place density tests according to ASTM D 1556 (sand cone method) or other test method as considered appropriate by Geotechnical Engineer.
 - a. Field in place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the

calibration curves furnished with the moisture gages according to ASTM D 3017.

- b. When field in place density 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 the Architect.
2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 3. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
 4. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in place density test for each 150 feet or less of trench, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.
- F. Owner's inspector will inspect foundation excavations when completed and ready for forms, after forms are in place, and before first placement of concrete.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace material to depth directed by the Architect; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

SECTION 31 31 32

IMPORT MATERIALS TESTING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the requirements for the sampling, testing, transportation and certification of imported fill materials to school sites.
- B. This Specification defines:
 - 1. CONTRACTOR requirements for use of imported materials on project sites.
 - 2. CONTRACTOR requirements for stockpiling materials for use on project sites.
 - 3. Testing requirements for all materials imported, stockpiled or generated for use on a project site.
 - 4. CONTRACTOR testing and reporting requirements.
 - 5. CONTRACTOR submittal requirements
- C. Provisions of the General Conditions and Division 01 apply to this section.

1.02 OBJECTIVES

- A. Ensure that fill materials imported to project sites are safe for students, staff and visitors.
- B. Ensure that representative data be collected so that analytical determinations can be made in regard to the first objective.
- C. Require CONTRACTOR to contract with and pay for the services of a licensed environmental professional (licensed State of California Professional Engineer [PE Civil], Professional Geologist [PG] or Registered Environmental Assessor II [REA II]) familiar with environmental site assessment and waste classification.
- D. Require CONTRACTOR to contract with and pay for an independent, approved California Department of Health Services certified testing laboratory to perform sampling and testing of imported and site generated fill materials.
- E. Require CONTRACTOR to pay all fees required by authorities having jurisdiction over area.
- F. Require CONTRACTOR to post bonds required by authorities having jurisdiction over area.

1.03 SUBMITTALS

- A. CONTRACTOR shall submit to OWNER'S Authorized Representative (OAR):
1. A qualifications statement for CONTRACTOR's independent California certified testing laboratory and required licensed environmental professional (California Professional Engineer [PE civil]), Professional Geologist [PG] or Registered Environmental Assessor II [REA II]) prior to the start of Work. CONTRACTOR's licensed environmental professional must possess recent demonstrated environmental experience in soil sampling and waste classification.
 - a. Testing laboratory must be pre-approved by the Division of State Architect.
 2. A draft import Sampling Strategy Plan (SSP) prepared by CONTRACTOR's licensed environmental professional for review and concurrence by the OAR. The objective of the SSP is to obtain representative sample data. The Draft SSP must be submitted at least 72 hours prior to all proposed import sampling activities.
 - a. At a minimum, the Draft SSP shall include a site map which shows the location of the proposed import and the location and number of the proposed stockpile samples. The draft SSP shall also contain information pertaining to the total volume of the stockpile proposed for sampling and the rationale in support of the proposed sampling approach. Existing environmental documentation specific to the import site shall be utilized by the CONTRACTOR's environmental professional to support the proposed sampling approach and analytical method suite. For new project sites, this information would include a DTSC approved site investigation report, e.g., Preliminary Environmental Assessment (PEA). It is the responsibility of the CONTRACTOR to request this information in advance from the OAR if they do not already have access to a copy at the jobsite.
 - b. Lacking this information or rationale, samples shall be analyzed for all analytical methods described in Section 3.01. Guidance for the minimum number of samples per stockpile volume is provided in Table 1 (supplemental samples may be required by the OAR if pothole stockpile sampling is utilized.). In addition, the draft SSP shall contain all necessary contact information for the import site and a proposed schedule for the sampling activities.
 - c. To expedite the review process, the Draft SSP shall be submitted electronically to the OAR in MS WORD format.
 - d. Upon revision of the draft SSP by the CONTRACTOR's licensed environmental professional and acceptance by the OAR, four revised copies of the final SSP will be provided to the OAR for distribution to OEHS and the project file.

3. A draft Certification/Sample Data Report prepared by CONTRACTOR's licensed environmental professional for review and concurrence. At a minimum the draft Certification/Sample Data Report shall contain:
 - a. a site map showing the location of the stockpile and stockpile sample locations;
 - b. a detailed discussion and evaluation of the laboratory results;
 - c. a summary of findings and recommendations that provide a determination on the waste classification of the subject materials, based on the representative sample results;
 - d. recommendations for additional steps, if any;
 - e. a chain-of-custody forms and all laboratory data with respective QA/QC sheets.
 - f. To expedite the review process, the Draft SSP shall be submitted electronically to the OAR in MS WORD format.
 - g. Upon revision of the draft Certification Report by the CONTRACTOR'S licensed environmental professional and acceptance by the OAR, three copies of the final report will be submitted to the OAR.
4. The Environmental Compliance Manager shall confirm that the proposed waste classification for the proposed import material is appropriate.
5. Written documentation, in the form of a memo or e-mail from CONTRACTOR to OAR, prior to import, verifying that the hauling contract specifies "clean" trucks and that the actual haul trucks utilized for import activities will be clean of visible contamination or deleterious materials.
6. Written documentation that the trucks went directly from the source location to the recipient location with no detours or stops at other locations and that short loads were not augmented by other materials that were not tested as part of the final import SSP. It is the CONTRACTOR's responsibility to document that no other trips or short-load augmentation occurred and submit to the documentation within five (5) business days of the completion of the import activities. All import transportation activities shall be conducted in accordance with all applicable (local, State, Federal) rules and regulations.
7. The independent approved testing laboratory shall perform the required tests and report results of all tests noting if the tested material passed or failed such tests and shall furnish copies to the IOR, Architect, OAR, DSA, Contractor, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, Title 24, CCR and the DSA. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to DSA as required by Title 24, CCR.

8. Certification, in the form of haul tickets or completed waste manifests, documenting the volume and recipient of all import materials and activities. This documentation shall be coordinated through the OAR Environmental Compliance Manager.
 - a. For approved import to new project sites, unregulated facilities (landfill) or non-project sites, haul tickets may be utilized, but shall contain the following minimum information:
 - 1) date of haul activity
 - 2) address of source
 - 3) address of recipient
 - 4) load volume
 - 5) time of departure from source
 - 6) time of arrival at recipient site
 - 7) signature of recipient or recipient's agent

1.04 APPROVALS

- A. NO import of earth or geotechnical grading or fill materials can occur at the project site without PRIOR approval by the OAR.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Imported
 1. Soils: Soils proposed for import shall be tested pursuant to the requirements of this Section.
 2. Gravels: Clean gravel, consisting of native rock from a commercial source, shall be tested pursuant to the requirements of this Section. Refer to Item 2.01.B, this Section, for the list of pre-tested sites
 3. Sands: Clean sand from a commercial source shall be tested pursuant to the requirements of this Section. CONTRACTOR shall provide written documentation, which identifies the source, volume and proposed transport date(s) of the material for review. Refer to Item 2.01.B, this Section, for the list of pre-tested sites:
 4. Miscellaneous Material: No miscellaneous material containing crushed concrete, asphalt, construction debris, or other potential deleterious materials may be utilized or imported to the project site for use as fill or grading material.
- B. Pre-Tested Sites:

Vulcan Materials Company
1709 Sherbon Street
Corona, CA 92879
Materials Tested: Sand, CAB, and 3/4 " Rock

LB Crushing Company
3100 Horseless Carriage Road
Norco, CA
Materials Tested: Sand

El Toro Materials
Rocky Road & Portola Parkway
Lake Forest, CA
Materials Tested: Sand

Hanson Aggregates North America-Inland Plant
12000 Banyan Street
Rancho Cucamonga CA 91730
Materials Tested: Sand

Hanson Aggregates North America-Irwindale
13550 Live Oak Avenue
Irwindale, CA 91706
Materials Tested: Sand

Inland Empire Regional Composting Authority (IERCA)
12645 Sixth Street
Rancho Cucamonga, CA 91739
Materials Tested: Top Soil and Mulch

- C. Import of fill Materials:
1. Fees: CONTRACTOR shall pay as required by authorities having jurisdiction over area.
 2. Bonds: CONTRACTOR shall post as required by authorities having jurisdiction over area.

PART 3 - EXECUTION

3.01 GRADING/EXCAVATION

- A. If the Contractor encounters an area(s) with discolored, stained, and/or odorous soils or any other evidence of contamination during excavation/grading work, Contractor must immediately notify District Representative, cease work in the aforementioned area(s), and secure the area(s) with fencing, tape, stakes or other suitable means to prevent entry by personnel or equipment. In turn, the District Representative which will initiate

a construction response to address the contamination, in accordance with pertinent regulatory requirements.

3.02 SAMPLING AND TESTING

- A. CONTRACTOR shall contract with, and pay for, the services of a licensed environmental professional (licensed State of California Professional Engineer [PE Civil], Professional Geologist [PG] or Registered Environmental Assessor II [REA II]).
- B. CONTRACTOR shall contract with, and pay for, an independent, approved California Department of Health Services certified testing laboratory to perform sampling and testing of imported, exported and site generated fill materials. [Note: Utilization of portable, onsite crushing equipment on the project site also requires prior notification and approval by the OAR].
- C. All imported fill/grading material, unless otherwise specified in writing by the OAR, must be tested at the site of origin. Import testing and certification process shall include the following steps:
 - 1. Stockpile all materials for sampling (standard stockpile or backhoe pothole stockpile). Crushed fill materials generated by CONTRACTOR at a project site must be segregated by material (e.g., separate stockpiles for concrete, asphalt, etc.).
 - 2. Submit Draft SSP for review and concurrence by OAR.
 - 3. Collect and analyze samples (see Table 1 for number of samples per volume) per SSP. Once fill materials for export have been stockpiled and tested, they may not be used onsite for any purpose without prior approval by the OAR.
 - 4. Submit draft import sample data report for review and concurrence by the OAR.
 - 5. Submit final import sample data report (Certification Report) to the OAR's Environmental Compliance Manager for concurrence of proposed waste classification.
 - 6. Submit required pre import documentation/record to the OAR (e-mail).
 - 7. Submit post import certifications to the OAR.
 - 8. In addition to the preceding, requirements, certifications and submittals as indicated in previous subsections above.
- D. OWNER retains the right to refuse any fill material proposed for use at a project site.
- E. Import fill materials shall be stockpiled by CONTRACTOR and are deemed acceptable for import or reuse only when it is demonstrated to the satisfaction of the OAR's Environmental Compliance Manager that the subject materials meet the requirements of this Section (01440).
- F. As described in Section 1.03B, lacking site-specific data or sample rationale to support a more focused analytical approach; the CONTRACTOR shall analyze all samples for the

following substances according to the methods indicated below. Table 3 is a waste classification flowchart for use by CONTRACTOR's environmental professional. In all cases, detection levels and quality assurance/quality control methods shall be in accordance with standard Method reporting limits and best laboratory practices and the following USEPA (EPA) methods:

1. Total Petroleum Hydrocarbons, utilizing EPA Method 8015M, for gasoline and diesel.
 2. Volatile Organic Compounds, utilizing EPA Method 8260B/5035.
 3. Polychlorinated biphenyls, utilizing EPA Method 8082.
 4. Semi-Volatile Compounds, utilizing EPA Method 8270C.
 5. Organochlorine Pesticides, utilizing EPA Method 8081A.
 6. Organophosphorous Pesticides, utilizing EPA Method 8141A.
 7. Chlorinated Herbicides, utilizing EPA Method 8151A.
 8. California Code of Regulations Title 22 (CAM 17) Metals, utilizing EPA Method 6010B/7470A.
 9. Hexavalent Chromium, utilizing EPA Method 7199.
 10. Arsenic/Thallium, utilizing EPA Method 6020.
- G. Import fill material may be deemed defective for use by the OAR at the project site if any of the following results are obtained:
1. Total Petroleum Hydrocarbons are present at concentrations exceeding 100 milligrams per kilogram (mg/kg) for gasoline and 1,000 mg/kg for oil/diesel and long chain hydrocarbons.
 2. Solvents and other volatile organic compounds are present at concentrations exceeding the laboratory reporting limit.
 3. Polychlorinated biphenyls are present at concentrations exceeding the laboratory reporting limit.
 4. Semi-volatile compounds are present at concentrations exceeding the laboratory reporting limit.
 5. Organochlorine pesticides are present at concentrations exceeding the laboratory reporting limit.
 6. Organophosphorous pesticides are present at concentrations exceeding the laboratory reporting limit.
 7. Chlorinated herbicides are present at concentrations exceeding the laboratory reporting limit.

8. California Code of Regulations Title 22 (CAM 17) Metals at concentrations exceeding site-specific background.
 9. Hexavalent chromium is present at concentrations exceeding 15 mg/kg.
- H. In addition to screening for hazardous materials, the imported soil must be tested and certified to be free of:
1. Organics and debris;
 2. Infestation by vermin or insects, in particular fire ants;
 3. Boron.
- I. Imported materials must be suitable for engineered fill, even if used at landscaping, free from large rocks.
- J. Imported materials shall not have a high clay content and must meet the permeability requirements of the projects hardscape if there is such requirement.
- K. Evaluate concentrations of metals in import fill by conducting the analysis set forth below.
1. Compare the maximum detected metal concentrations in import fill samples to the Threshold Criteria listed in Table 4. If any metal concentration exceeds its listed background value, the fill material fails and shall be deemed defective and unacceptable for use at the project site unless supported by a site specific health risk assessment.
 2. In addition to section 3.01.G.1, import fill shall be deemed environmentally defective and unacceptable for use if any of the following results are obtained:
 - a. Arsenic concentrations exceed 12.0 mg/kg.
 - b. Lead concentration exceeds 255 mg/kg or fails TTLC/STLC.
 - c. Import materials at new project sites with total chromium concentrations greater than or equal to 100 mg/kg shall be tested for hexavalent chromium.
- L. All import fill material shall be characterized, handled, and documented in accordance with applicable US EPA and State of California hazardous waste and hazardous materials regulations (See Table 2). For the purpose of this specification, “contaminated” shall mean any soil or geotechnical material at a concentration, which would require disposal at a regulated facility (i.e., California hazardous or RCRA hazardous). OAR must be notified at least 72 hours prior to the disposal of any hazardous waste or hazardous material. No material disposal or reuse can take place without prior written approval of the OAR.
- M. Specification test results and OAR approvals shall be valid for a period of 120 days from the date of the subject testing unless a variance is requested by CONTRACTOR and

approved by OAR. Previously approved materials shall not be utilized or disposed offsite after the 120 day limit without prior review and approval by the OAR.

- N. Requests for variances to this Specification shall be submitted in writing to the OAR a minimum of two weeks in advance of need for review and approval. The request for variance must provide all available testing data, a rationale to support the request and have an active funding line (provided by OAR) to facilitate review by the OAR. OAR will review the request for variance and will provide its preliminary determination within two weeks. Certain requests may require final approval by the Department of Toxic Substances Control (DTSC).
- O. Soils with concentrations above Section 01440 screening levels may, upon prior approval by the OAR, may be reused at other project sites if supported by a site-specific human health risk assessment.
- P. Details of the samples and testing must be submitted to and approved by the OAR’s Environmental Compliance Manager before transportation.
- Q. Haul Routes and Regulations/Restrictions: CONTRACTOR must comply with requirements of project EIR (CEQA) and authorities having jurisdiction over the project area and the proposed activities (e.g. Regional Water Quality Control Board, Department of Toxic Substances Control, etc.).

3.03 TRANSPORTATION

- A. CONTRACTOR shall pay all fees required by authorities having jurisdiction over area.
- B. Contractor shall pay all fees for disposal and/or processing of contaminated and/or hazardous fill materials at a regulated facility.
- C. CONTRACTOR shall post and pay for all bonds required by authorities having jurisdiction over area.

TABLE 1: MINIMUM SAMPLING FREQUENCY	
Volume (Cubic Yards)	Sampling Frequency
0 – 1,000	1 per 250 CY
1,001 - 5,000	4 samples per first 1,000 CY and 1 sample per each additional 500 CY
Greater than 5,000	12 samples for first 5000 CY and 1 sample per each additional 1,000 CY

Chemicals of Potential Concern	TABLE 2 WASTE CHARACTERIZATION				
	Hazardous Waste if Exceed Criteria - TTLC Level* (mg/kg)	Additional WET Leaching Tests if Exceed Hazardous Waste Criteria - 10 times STLC Level** (mg/kg)	California-Regulated Hazardous Waste - Soluble Threshold Limit Concentration -STLC Level (mg/l)	Additional TCLP Leaching Tests if Exceed Hazardous Waste Criteria - 20 times TCLP Level** (mg/kg)	Federally-Regulated (RCRA) Hazardous Waste - Toxicity Characteristic Leaching Procedure - TCLP Level (mg/l)
CAM 17 Metals					
Antimony	500	150	15	NA	NA
Arsenic	500	50	5	100	5
Barium	10,000	1,000	100	2,000	100
Beryllium	75	7.5	0.75	NA	NA
Cadmium	100	10	1	20	1
Chromium	2,500	50	5	100	5
Cobalt	8,000	800	80	NA	NA
Copper	2,500	250	25	NA	NA
Lead	1,000	50	5	100	5
Mercury	20	2	0.2	4	0.2
Molybdenum	3,500	3,500	350	NA	NA
Nickel	2,000	200	20	NA	NA
Selenium	100	10	1	20	1
Silver	500	50	5	100	5
Thallium	700	70	7	NA	NA
Vanadium	2,400	240	24	NA	NA
Zinc	5,000	2,500	250	NA	NA
<i>Chromium (VI)</i>	500	50	5	NA	NA

TABLE 3 – WASTE CLASSIFICATION FLOWCHART

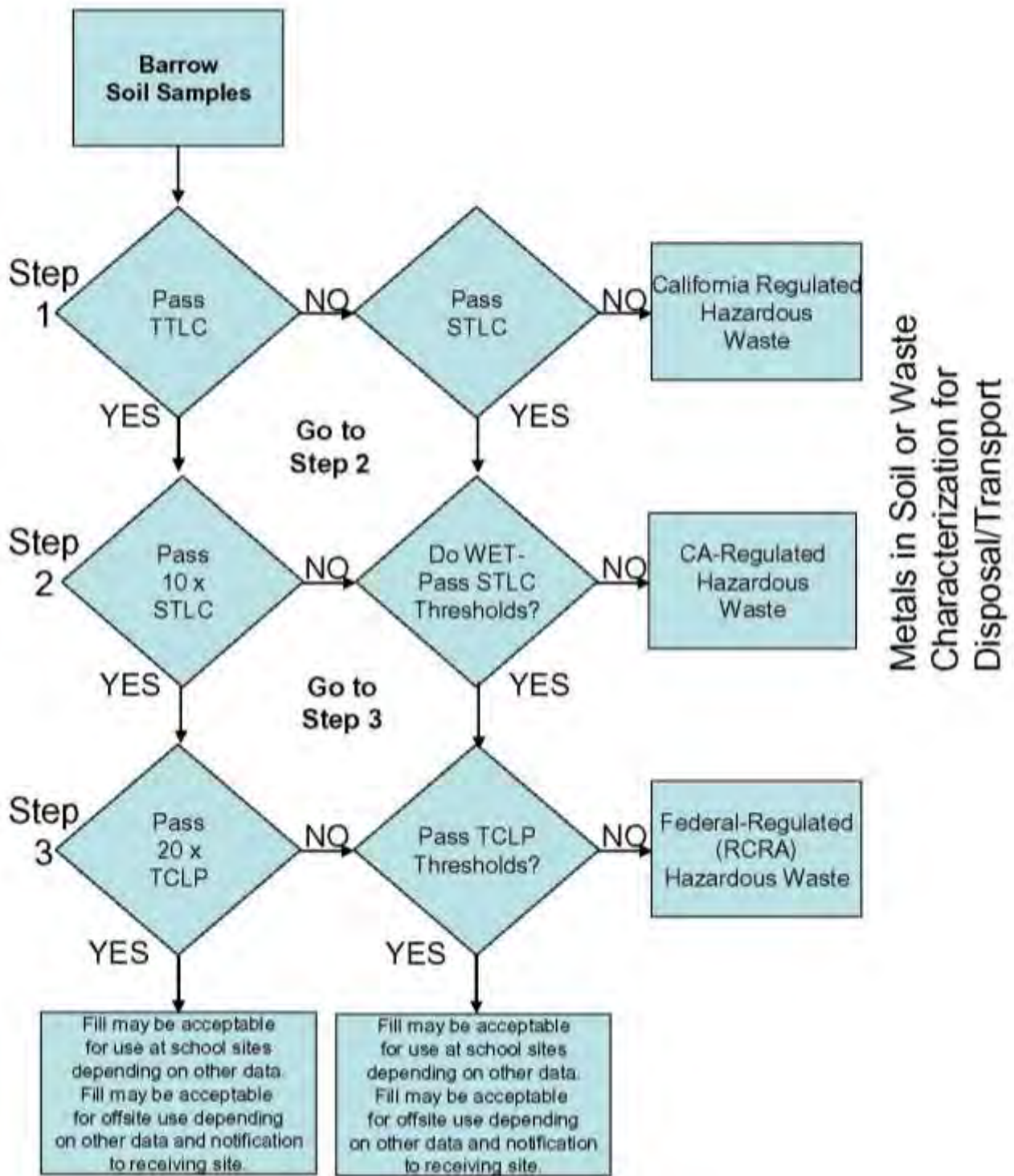


TABLE 4: THRESHOLD CRITERIA FOR METALS IN SOIL - LOOK UP VALUES

CAM 17 Metals	Soil Threshold Criteria (mg/kg)	Basis
Antimony	28	NC
Arsenic	11.3	BK
Barium	2330	NC
Beryllium	16	C
Cadmium	1.4	C
Chromium	106656	NC
Cobalt	4266	NC
Copper	2631	NC
Lead	255	PbB
Mercury	21	NC
Molybdenum	356	NC
Nickel	148	C
Selenium	356	NC
Silver	356	NC
Thallium	4.7	NC
Vanadium	498	NC
Zinc	21331	NC

NC = noncancer health effects

BK = background

C = cancer risk

PbB = blood lead levels

END OF SECTION

SECTION 31 71 23

FIELD ENGINEERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Surveying requirements for the Work.

1.02 RELATED SECTIONS

- A. Section 31 20 00: Earthwork
- B. Section 32 12 16: Asphalt Paving
- C. Section 33 40 00: Storm Drainage Utilities

1.03 SURVEY SERVICE

- A. Unless otherwise stated by the Architect or noted in the Special Provisions, the CONTRACTOR shall provide all surveying services.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

3.01 SUBMITTALS

- A. CONTRACTOR shall submit the name and address of the State of California licensed surveyor to Construction Management Representative (CMR), ARCHITECT and OWNER including any changes as they may occur.
- B. CONTRACTOR shall submit to OWNER copies of cut sheets, coordinate plots, data collector printouts, and other documentation as available to verify completeness and/or accuracy of field surveying work.
- C. Statement of Compliance: CONTRACTOR shall submit a statement of certification signed and sealed by Surveyor, counter-signed by CONTRACTOR indicating compliance with grade elevations, slopes and tolerances.

3.02 LAYOUT OF THE WORK

- A. CONTRACTOR shall employ a State of California licensed surveyor to lay out the entire Work, set grades, lines, levels, control points, vertical and horizontal control, elevations, grids and positions. Before the commencement of Work, surveyor shall, in conjunction with OWNER and Construction Management Representative (CMR) provided engineering survey of the Project site, locate all reference points and benchmarks, then

lay out all lines, elevations, and measurements for the entire Work including but not limited to, buildings, grading, paving and utilities.

- B. All work under this contract shall be built in accordance with the lines and grades shown on the plans. Field survey for establishing these, and for the control of construction, shall be the responsibility of the Contractor. All such survey work including construction staking shall be done under the supervision of a California Licensed Land Surveyor or authorized Civil Engineer. Staking shall be done on all items ordinarily requiring grade and alignment, at intervals normally accepted by the agencies and trade involved.
- C. The CONTRACTOR shall be responsible for any errors in the finished work, and shall notify the Engineer, in writing, within 24 hours, of any discrepancies, or design errors during the construction staking.
- D. Contractor shall immediately remediate any areas found not to meet specification requirements.

3.03 SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent horizontal and vertical control points on the Project site, remote from the work area, referenced to data established by the survey control points.
- B. Indicate the reference points on the project record drawings with the basis of elevation being the established benchmarks.
- C. Establish lines, grades, locations and dimensions by instrumentation. From time to time, verify the layout of all Work by the same methods.
- D. Provide grade stakes and elevations to construct over excavation and re-compaction, rough and final grades, paved areas, curbs, gutters, sidewalks, building pads, landscaped areas, and other areas as required.
- E. Calculate and layout proposed finished elevations and intermediate control as required to provide smooth transitions between the spot elevations indicated in the Contract Documents.
- F. Provide stakes and elevations for grading, fill, and topsoil placement.
- G. Provide adequate horizontal and vertical control to locate utility lines, including but not limited to, storm, sewers, water mains, gas, electric and signal and provide vertical control in proportion to the slope of the line as required for accurate construction. Dry utilities will be based upon adequate horizontal and vertical control layout. Prior to trench closure, survey and record invert and flow line elevations. Survey and record top of curb and flow line elevations on finished concrete or AC surfaces at key locations such as BC's, EC's, grade breaks, corners or angle points in sufficient number to demonstrate the Work complies with the intent of the Contract Documents.
- H. Provide horizontal and vertical control for batter boards for drainage, utility, and other on-site structures as required.

- I. Furnish building corner offsets as required to adequately locate building pads. Provide cut and fill stakes within the building pad perimeter adequate to control both over excavation and re-compaction and the final sub-grade elevation of the building pad.
- J. Submit a certification, signed by the surveyor, confirming the elevations and locations of improvements are in conformance with the Contract Documents. The statement shall include survey notes for the finish floor and building pad, showing the actual measured elevations on the completed sub-grade, recorded to the nearest 0.01'. Building pad tolerance will be +/- 0.10'.

3.04 ESTABLISHMENT OF GRADES IN HARDSCAPE AREAS

- A. All work shall conform to the lines, elevations, and grades shown on the Grading Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.
- B. Areas having drainage gradients of 2 percent or more shall have elevation stakes, set with instrument, at grid intervals of 25 feet. Intermediate stakes may be set by using a tightly-drawn string line over the tops of adjacent stakes. Grade stakes must be set at all grade breaks, grade changes, etc.
- C. Areas having drainage gradients of less than 2 percent shall have elevation stakes, set with instrument, at 10 foot intervals. Grade stakes must be set at all grade breaks, grade changes, etc.
- D. Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.

3.05 STORM DRAIN & SEWER PIPE INSTALLATION

- A. All storm drain & sewer pipelines, catch basins and drain inlets shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the Inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.

3.06 RECORD DRAWINGS

- A. Upon Substantial Completion, CONTRACTOR shall obtain and pay for reproducible transparencies of the as built survey drawings. Deliver to ARCHITECT, final "record" drawings of the original drawings and completed Work within specified tolerances.
- B. Record drawings shall indicate locations by coordinate of all utilities onsite with top of pipe elevations at major grade and alignment changes, rim grate or top-of-curb and flow line elevations of all drainage structures and manholes.
- C. Completed record drawing transparencies shall be signed and certified as correct and within specified tolerances by the licensed surveyor.

- D. Attention is called to other sections of the Contract Documents requiring verification or measurements of installed Work by survey. Surveyor shall perform and certify all such surveys or verification are completed in accordance with the Contract Documents.

END OF SECTION

SECTION 31 74 16

STORM WATER POLLUTION PREVENTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Preparation, implementation and monitoring of Storm Water Pollution Prevention Plan (SWPPP) for the purpose of preventing the discharges of pollutants from the construction site into the receiving waters. This includes elimination of non-storm water pollution discharges such as improper dumping, spills or leakage from storage tanks or transfer areas.
- B. Compliance with all local, state and federal regulations governing storm water discharges associated with construction activities such as, but not limited to clearing, excavating, grading, demolition and other land disturbances.
- C. Payment of application and annual fees required by the State Water Resources Control Board (SWRCB) for the duration of the construction of the Project.
- D. Submittal of all Permit Registration Documents (PRDs) through the SWRCB SMARTS online system.
- E. Certification that the construction project has met all of the conditions of the General Construction Storm Water Permit (GCSWP).

1.02 REFERENCES

- A. National Pollutant Discharge Elimination System (NPDES) General Permit No CAS000002.
- B. State Water Resources Control Board (SWRCB) Water Quality Order 2009-0009-DWQ, as amended by 2010-0014-DWQ and 2012-006-DWQ.
- C. California Stormwater Quality Association, Stormwater Best Management Practice Handbook, Construction, latest edition.

1.03 RELATED DOCUMENTS

- A. Project Contract, including General, Special and Supplementary Conditions and other General Requirements.

1.04 ACRONYMS AND DEFINITIONS

BMP	Best Management Practice.
CAN	Corrective Action Notice.
CASQA	California Stormwater Quality Association.
COI	Change of Information.

DWQ	Division of Water Quality.
CGP	NPDES General Permit for Storm Water Discharges Associated with Construction Activities.
ELAP	Environmental Laboratory Accreditation Program.
LRP	Legally Responsible Person (OWNER).
NOI	Notice of Intent.
NOT	Notice of Termination.
NPDES	National Pollutant Discharge Elimination System.
OEHS	LAUSD Office of Environmental Health and Safety.
PRDs	Permit Registration Documents, including NOI, Risk Assessment, Site Map, SWPPP, Annual Fee, Signed Certification Statements.
REAP	Rain Event Action Plan.
RISK LEVEL	As defined by CGP.
QSD	Qualified SWPPP Developer.
QSP	Qualified SWPPP Practitioner.
QRE	Qualifying Rain Event, is an event that produces 0.5 inches of precipitation with a 48 hour or more period between rain events.
SMARTS	Storm Water Multiple Application and Report Tracking System (smarts.waterboard.ca.gov).
SWPPP	Storm Water Pollution Prevention Plan.
SWRCB	State Water Resources Control Board.
WPCD	Water Pollution Control Drawings.
WDID	Waste Discharge Identification Number.

1.05 SUBMITTALS

- A. Contractor's QSD shall submit the Notice of Intent and all Permit Registration Documents and the Notice of Intent fee required by SWRCB.
- B. Contractor's QSD shall prepare and submit the Storm Water Pollution Prevention Plan for this project to the State Water Resources Control Board (SWRCB) via SMARTS.

- C. The Contractor's QSD shall prepare the SWPPP, including the WPCD, Risk Level Determination, and Post Construction Water Balance Calculation. Copies of these documents shall be provided to the Contractor. Contractor at his discretion may accept SWPPP as is, modify it, or develop his own.
- D. Contractor shall submit qualifications and experience of the QSD & QSP for Owner's review and acceptance.
- E. Contractor shall submit electronic copies of weekly and quarterly inspections, annual reports, compliance certifications, and test results.
- F. Contractor shall submit the annual report. The General Permit requires all projects that are enrolled for more than one continuous three-month period to submit information and annually certify that their site is in compliance with these requirements. All dischargers must prepare and electronically submit an annual report no later than September 1 of each year using the Storm water Multi-Application Reporting and Tracking System (SMARTS). The Annual Report must include a summary and evaluation of all sampling and analysis results, original laboratory reports, chain of custody forms, a summary of all corrective actions taken during the compliance year, and identification of any compliance activities or corrective actions that were not implemented.
- G. Within 90 days of when construction is complete or ownership has been transferred, the Contractor shall electronically file a Notice of Termination (NOT), a final site map, and photos through the State Water Boards SMARTS system. Filing a NOT certifies that all General Permit requirements have been met.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Storm Water Pollution Prevention Plan: The Contractor's QSD shall provide the quality, grade and type of materials as specified in Stormwater Best Management Practice Handbook, Construction, latest edition, and State Water Resources Control Board (SWRCB) Water Quality Order 2009-0009-DWQ, as amended by 2010-0014-DWQ and 2012-006-DWQ.
- B. The Contractor shall have available on-site during construction activities a non-stormwater sampling kit suitable for obtaining storm water and non-stormwater quality grab samples. Kit shall include containers and preservatives appropriate for the pollutants known or expected to be in the stormwater. Required sampling equipment shall be adequate to capture and transport samples to a local ELAP State certified water testing lab.
- C. Provide a rain gauge on site to record readings during site inspections.

PART 3 - EXECUTION

3.01 SWPPP IMPLEMENTATION

- A. The Contractor shall hire a Qualified SWPPP Practitioner (QSP), as defined by the Construction General Permit, to implement the Storm Water Pollution Prevention Plan to be consistent with the requirements of SWRCB Water Quality Order 2009-0009-DWQ, as amended by 2010-0014-DWQ and 2012-006-DWQ, and as follows:
- 1) Install perimeter controls and sediment control BMPs prior to starting construction work at the site.
 - 2) Install effective erosion control BMPs at the jobsite.
 - 3) Protect exposed dirt, such as stockpiles, landscaping areas, and hillsides.
 - 4) Properly manage non-storm water discharges such as ground water, broken utility lines and fire hydrant testing per CGP requirements.
 - 5) Contain on-site storm water at the jobsite. Do not drain on-site water directly into the storm drains.
 - 6) QSP to train personnel for the proper implementation of the SWPPP.
 - 7) Revise the SWPPP to suit changing site conditions and also when properly installed systems are ineffective.
 - 8) Adjust BMP's locations and layouts in accordance to construction progress to assure compliance to regulations.
 - 9) Conduct inspections of pollution prevention controls and provide Site Monitoring Report to OAR immediately if pollutants are discharged into the site runoffs. CONTRACTOR shall sample and remediate contaminated water.
 - 10) QSP to develop and implement Rain Event Action Plans (REAPs).
 - 11) QSP to perform and oversee all monitoring consistent with the identified Risk Level for the site.
 - 12) Notification and Report: If pollution occurs in the work area for any reason or when the Contractor becomes aware of any violation of this Section, correct the problem and immediately notify the Inspector. In addition, submit a written report to the Project Civil Engineer within seven (7) calendar days describing the incident and the corrective actions taken. If either the Inspector or Engineer is first to observe pollution or a violation, the Contractor shall also explain in the written report why the Work was inadequately monitored.
 - 13) Revise SWPPP to suit changing site conditions and also when properly installed systems are ineffective.
 - 14) Upon Substantial Completion: Maintain and leave post-construction storm water pollution prevention controls in place and remove those that are not needed as determined by the QSD and OAR.
 - 15) QSP shall submit the annual report. All dischargers must prepare and electronically submit an annual report no later than September 1 of each year

using the Storm water Multi-Application Reporting and Tracking System (SMARTS). The Annual Report must include a summary and evaluation of all sampling and analysis results, original laboratory reports, chain of custody forms, a summary of all corrective actions taken during the compliance year, and identification of any compliance activities or corrective actions that were not implemented.

3.02 MONITORING

- A. The Contractor shall conduct examination of storm water pollution prevention controls according to the monitoring requirements identified for the projects risk level as defined by the Construction General Permit.
- B. The Contractor shall prepare and maintain, at the jobsite, a log of each inspection using Site Monitoring Report forms.
- C. The Contractor shall distribute copies of the Owner provided Storm Water Pollution Prevention Plan to their superintendent and subcontractors. At least one (1) copy of the SWPPP shall be available on site at all times.

3.03 SWPPP LIABILITIES AND PENALTIES

- A. Review of the inspection logs by the Owner shall not relieve the Contractor from liabilities arising from non-compliance with storm water pollution regulations.
- B. Payment of Penalties for non-compliance by the Contractor shall be the sole responsibility of the Contractor and will not be reimbursed by the Owner.
- C. Compliance with the Clean Water Act and the State Water Resources Control Board (SWRCB) Water Quality Order 2009-0009-DWQ pertaining to construction activities is the sole responsibility of the Contractor. For any fine(s) levied against the Owner due to non-compliance by the Contractor, the Owner will have the option to either require payment by Contractor of, or deduct from any payments due the Contractor, the total amount of the fine(s) levied on the Owner and associated costs.

3.04 SWPPP CLOSEOUT

- A. Verify the following prior to Substantial Completion of SWPPP:
 - 1) Elements of the SWPPP have been completed.
 - 2) Final stabilization of site, as defined by the GCP, has been demonstrated.
 - 3) There is no potential for construction related storm water pollutants to be discharged into site runoff.
 - 4) Construction related equipment and temporary BMPs have been removed from site.
 - 5) Rubbish, debris, and waste materials have been removed and legally disposed of off the Project site.

6) Post-Construction BMP Maintenance Plan has been established.

END OF SECTION

SECTION 32 01 90

TREE AND SHRUB PRESERVATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the protection and trimming and root pruning of trees that interfere with, or are affected by, execution of the Work, whether temporary or new construction.

1.2 RELATED WORK NOT IN THIS SECTION:

- A. Section 32 90 00: Landscape Planting

1.3 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of landscape architects and owners, and other information specified.
- B. Certification from a qualified arborist 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.
- C. Maintenance recommendation from a qualified arborist for care and protection of trees affected by construction during and after completing the Work.

1.4 QUALITY ASSURANCE

- A. Arborist Qualifications: An arborist certified by the International Society of Arboriculture or licensed in the jurisdiction where Project is located.
- B. Tree Pruning Standards: Comply with ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance--Standard Practices," unless more stringent requirements are indicated.
- C. Pre-installation Conference: Before starting tree protection and trimming, meet with representatives of authorities having jurisdiction, Owner, Landscape Architect, consultants, and other concerned entities. Review tree protection and trimming procedures and responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than 10 percent passing a 3/4-inch sieve.
- B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches or more; do not obtain from bogs or marshes.
- C. Filter Fabric: Manufacturer's standard, non-woven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.
- D. Chain Link Fence: Metallic-coated steel chain link fence fabric, 0.120-inch- diameter wire size; 72 inches high, minimum; line posts, 1.9 inches in diameter; terminal and corner posts, 2-3/8 inches in diameter; top rail, 1-5/8 inches in diameter; bottom tension wire, 0.177 inch in diameter; with tie wires, hog ring ties, and other accessories for a complete fence system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before construction begins, fertilize affected trees to improve tree vigor and health. Soil analysis testing should be completed to assure fertilization with the appropriate fertilizer products.
- B. Temporary Fencing: Install temporary fencing located at or outside the drip line of trees.
- C. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.
- D. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems.
- E. Do not allow fires under or adjacent to remaining trees or other plants.

3.2 EXCAVATION

- A. Do not excavate within drip line of trees.

- B. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
 - 1. Cut roots approximately 3 inches back from new construction.
 - 2. 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. Protect roots from damage until they are permanently relocated and covered with soil.
- C. Where utility trenches are required within drip line of trees, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.
- D. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 TREE PRUNING

- A. Prune tree canopies and branches at the direction of the project arborist to remove any dead or broken branches, and to provide the necessary clearances for the construction equipment.
- B. Root prune existing street trees to prevent sidewalk and curb damage.
- C. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist.
- D. Pruning Standards: Prune trees according to ANSI A300 as follows:
 - 1. Crown cleaning.
 - 2. Crown thinning.
 - 3. Crown reduction.
- E. Cut branches with sharp pruning instruments; do not break or chop.

3.4 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the qualified arborist.
- B. Remove and replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern.
- C. Provide new trees of the same size and species as those being replaced; plant and maintain as specified in Division 2 Section "Landscape Planting."

3.5 SOIL AERATION

- A. Aerate surface soil compacted during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches deep at 24 inches on center. Backfill holes with an equal mix of augured soil and sand.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted.
- B. Disposal: Remove excess excavated material, displaced trees, and excess chips from Owner's property.

END OF SECTION 32 01 90

SECTION 32 01 91
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), 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, flowering bulbs, and naturalized wildflowers.
- D. Operate permanent irrigation system.
- E. Clean up landscaped areas.
- F. Maintenance Period: The time frame covered by these requirements is 365 days:
 - 1. Start Date: Project Date of Substantial Completion.

1.02 RELATED REQUIREMENTS

- A. Section 31 20 00 - Earthwork.
- B. Section 32 84 00 - Planting Irrigation.
- C. Section 32 90 00 - Landscape Planting.

1.03 REFERENCE STANDARDS

- A. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2008 (R2014).
- B. ANSI Z133.1 - American National Standard For Arboricultural Operations - Pruning, Repairing, Maintaining, And Removing Trees, And Cutting Brush - Safety Requirements; 2012.
- C. ASTM C602 - Standard Specification for Agricultural Liming Materials; 2013a.
- D. ASTM D4972 - Standard Test Method for pH of Soils; 2013.

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 33 00 - Submittal Procedures, 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 63 00 - Product Substitution Procedures.

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. Granite Chips: See Section 32 15 31 - Decomposed Granite Surfacing
- 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 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.
- 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.

3.05 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.

3.06 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 conforming to 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.

3.07 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.

3.08 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 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 REQUIREMENT

- A. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the work as indicated in the Contract Documents and specified herein.
- B. The following types of pavement shall be covered in this Section:
 - 1. Paving for utility trenching, parking lots, areas between buildings, adjacent to planting and turf areas, and as indicated on Construction Documents.
- C. Related Sections:
 - 1. Section 31 20 00: Earthwork.
 - 2. Section 32 12 36: Seal Coat.
 - 3. Section 32 17 13: Pavement Markings.

1.2 Quality Assurance

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".
- B. The Owner's inspector shall test the temperature of each batch of asphaltic concrete prior to placement. At the time of delivery to the work site, the temperature of mixture shall not be lower than 260 degrees F or higher than 320 degrees F, the lower limit to be approached in warm weather and the higher in cold weather. If asphaltic concrete temperature is not within these tolerances the affected batch shall be rejected. Any and all costs due to the rejected asphaltic concrete shall be the responsibility of the paving contractor.

1.3 Establishment of Grades

- A. The Contractor's Surveyor will set grade stakes. The Surveyor shall be a California registered land surveyor or licensed Civil Engineer. The Surveyor shall be hired and paid by the Contractor, and shall be subject to the approval of the Owner. Contractor shall notify the Owner at least 48 hours before staking is to be started. The Owner will determine if work is ready for staking.
- B. All work shall conform to the lines, elevations, and grades shown on the Construction Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer.

In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.

- C. Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.
- D. Areas having drainage gradients of 2 percent or more shall have elevation stakes, set with instrument, at grid intervals of 25 feet. Intermediate stakes may be set by using a tightly-drawn string line over the tops of adjacent stakes. Grade stakes must be set at all grade breaks, grade changes, etc.
- E. Areas having drainage gradients of less than 2 percent shall have elevation stakes, set with instrument, at 10 foot intervals. Grade stakes must be set at all grade breaks, grade changes, etc.

1.4 Submittals

- A. Mix Designs: The CONTRACTOR shall formulate a job-mix formula using the Hveem method in accordance with Standard Specifications Section 203-6.2 and submit it to the ENGINEER for approval. The resultant mixture shall have Hveem properties conforming to Standard Specifications Section 203-6.4.3.
- B. Samples:
 - 1. Prior to the delivery of specified aggregate to the site, the CONTRACTOR shall submit samples of the material for the INSPECTOR's acceptance in accordance with Standard Specifications 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. Aggregate base gradation and quality certifications shall be dated within 30 days of the submittal.
- C. Certificates
 - 1. Twenty days prior to the delivery of aggregates, asphalt materials, and paving mixes to the project site, the Contractor shall submit to the Engineer certificates and test results of compliance of such materials with these specifications.
 - 2. Submit certificates of compliance from the supplier for bituminous materials for paint binder, asphaltic concrete, and seal coat.
 - 3. Submit weigh master's certificates or certified delivery tickets for each truck load of asphaltic material delivered to the project site.
 - 4. 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.

1.5 Quality Control

- A. 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.
- B. 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. Regulatory Requirements: The quantity of volatile organic compounds (V.O.C.) used in weed killer, seal coat, primer and other materials shall not exceed the limits permitted under the current regulations of the local authorities having jurisdiction.

1.6 Environmental Limitations

- A. Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 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.

1.7 Pavement-Marking Paint

- A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Base Course Material: Crushed aggregate base material shall consist of materials that meet the provisions of Specifications Section 31 20 00 Earthwork, Part 2.01-F.
- B. Asphalt Surfacing Materials: Furnish asphalt surfacing meeting the following requirement, furnished from a commercial asphalt central mixing plant.
 - 1. Paint Binder/Tack Coat: Asphalt emulsion shall be CSS-1 or CSS-1h and shall conform to the requirements of Standard Specifications Section 203-3 Emulsified Asphalt.
 - 2. Asphalt Concrete Composition & Grading:
 - a. Surface course asphalt concrete in other areas shall conform to Standard Specification Section 203-6.4.3, Type C2, with asphalt content of 4.6% to 6.0%.
 - b. Base course asphalt concrete, in all areas, shall conform to Standard Specification Section 203-6.4.3, Type B, with asphalt content of 4.5% to 5.8%.
 - c. Asphalt performance grade shall be PG-64-10.

- d. At least two courses of asphalt shall be laid when Type C2 asphalt pavement is greater than 3 inches. The surface course shall be a minimum thickness of one inch (1") and a maximum of two inches (2").

C. Weed Control:

1. The soils sterilant shall be in accordance with current EPA acceptable standard and the California Department of Pesticide Regulations for soils sterilant. Sterilant shall be selected as appropriate for the environment in which it is to be placed. Contractor shall be licensed with the State of California to apply sterilant. Sterilant shall be commercial grade for commercial application. Payment for soil sterilization will include full compensation for application and all materials and incidental work required.
2. Apply Dow Elanco Spike 80DF, or approved equal, to subgrade prior to asphalt paving at locations shown on plan. Spike 80DF weed control should be applied at the rate of seven pounds per acre. If another manufacturer is used follow their recommendations.

D. Headers and Stakes:

1. Headers: Redwood, Construction Heart Grade, size 2 x 6, unless otherwise indicated on construction drawings
2. Stakes: 2 x 4 redwood or 2 x 3 Douglas fir, Construction Grade.
3. Nails: Common, galvanized, 12d minimum.

PART 3 - EXECUTION

3.1 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. 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.
- C. 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.
- 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 anchorage as required to fasten headers in place

3.2 SUBGRADE PREPARATION

- A. Subgrade Preparation:
 - 1. It is required that asphalt concrete pavement be underlain by crushed aggregate base (CAB) material, thickness as noted on the plans, which meets the provisions of S.S.P.W.C. Section 200-2.2. CAB shall be placed and compacted to a minimum of 95% of maximum density.
 - 2. See project soils report section 4.1.3 for subgrade preparation requirements.
- B. The above subgrade preparation recommendations are based on the assumption that soils encountered during field exploration are representative of soils throughout the site. 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.
- C. A California Licensed Surveyor (LS) must provide grade stakes and elevations for the Geotechnical Engineer to verify that the over-excavation depths, shown on the construction drawings for asphalt concrete pavement structural sections, have been achieved prior to re-compaction.
- D. Subgrade tolerances: Subgrade for pavement shall not vary more than 0.02' from the specified grade and cross section established by the Engineer. Subgrade for subbase or base material shall not vary more than 0.04' from the specified grade and cross section. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.
- E. Correct irregularities by dressing down or filling as may be required, to bring areas to true subgrade elevations.
- F. Where filling is required, scarify the subgrade to bond the new material to the in place material; use additional material as required, subject to the approval of the Architect, and provided by the Contractor.
- G. Remove excess material from the site to a legal disposal area.

3.3 APPLICATION GENERAL

- A. Finish elevations, extent of asphalt paving and locations of type of asphalt and class of base shall be as indicated and specified herein and on the Construction Documents. Bring subgrade elevations sufficiently below the finish elevations of the paving so as to accommodate the thickness of paving and base.

3.4 STERILANT APPLICATION

- A. Place herbicide below base course. Meet the applicable environmental control requirements. Apply as directed by the manufacturer's printed instructions just before application of the base course. Sterilant shall not be applied within two feet of planting areas.

3.5 APPLICATION OF BASE COURSE

- A. Install base course material, encompassing spreading and compacting, in accordance with the S.S.P.W.C. Section 301-2, Untreated Base.
- B. After preparing the subgrade as specified in 3.5.A, all traffic on the subgrade shall be avoided. Should it be necessary to haul over the prepared subgrade, the CONTRACTOR shall drag and roll the traveled way as frequently as may be necessary to remove ruts, cuts, and breaks in the surface. All cuts, ruts, and breaks in the surface of the subgrade that are not removed by the above operations shall be raked and hand tamped. All equipment used for transporting materials over the prepared subgrade shall be equipped with pneumatic tires.
- C. Continued use of sections of prepared subgrade for hauling, so as to cut up or deform it from the true cross-section, will not be permitted. The CONTRACTOR shall protect the prepared subgrade from all traffic.
- D. Maintain the surface in its finished condition until the succeeding layer is placed.

3.6 PLACING ASPHALT CONCRETE SURFACING:

- A. Asphalt binder (tack coat) shall be applied to all existing pavement surfaces to be overlaid and/or joined per section 302-5.4 of the Standard Specifications. Asphalt binder (tack coat) shall be applied to existing surfaces to be surfaced and between layers of asphalt concrete, except when eliminated by the Engineer. A layer of asphalt binder (tack coat) shall be applied to all vertical-cut faces and between subsequent AC lifts.
- B. Asphalt Concrete Pavement:
 - 1. All work shall be in accordance with Section 302-5 of the Standard Specifications, except as noted herein. Asphalt concrete work shall include full-depth patching and variable thick asphalt concrete transition areas. The Contractor shall, on a daily basis, provide the Inspector with copies of certificates of weight for all materials delivered to the job site and/or incorporated in the work. At no time shall the coarse aggregate that has segregated from the mix be scattered across the paved mat.
 - 2. Asphalt concrete shall not be placed on any surface, which contains ponded water or excessive moisture in the opinion of the Engineer. 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. The Contractor shall furnish and use 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 by the Engineer
 - 3. The Inspector will examine the base before the paving has begun. The Contractor will correct any deficiencies before the paving is started.
 - 4. Asphalt concrete of the class indicated in Section 2.B.2 shall be laid in courses conforming to S.S.P.W.C. Table 302-5.5(A) unless otherwise stated herein.
 - 5. At least two courses shall be laid when Type C2 asphalt pavement is greater than 3 inches. The surface course shall be a minimum thickness of one inch (1") and a maximum of two inches (2").
 - 6. Successive courses may be laid upon previously laid courses as soon as the previous course has cooled sufficiently to show no perceivable displacement under equipment or loaded material delivery trucks and a tack coat has been applied.

7. Wherever AC pavement does not terminate against a curb, gutter, or another pavement, the Contractor shall provide and install a redwood or pressure treated Douglas fir header at the line of termination.
8. Smoothness of asphalt shall conform to section 302-5.6.2 of the Standard Specifications
9. Density shall conform to the below requirements:
 - a. In-place density of the Asphalt Concrete will be based on test results from a nuclear gauge and core samples taken in accordance with CTM 375, "Determining the in Place Density and Relative Compaction of Asphalt Concrete Pavement" except as modified below. The Inspector will determine when core sample testing shall be completed.
 - b. Asphalt Concrete shall be compacted to not less than 95.0 percent for a single test and not less than an average in place density of 96.0 percent relative compaction of the Laboratory Test Maximum Density as determined by, Caltrans Testing Method (CTM) 375 except as modified by these specifications.
 - c. The materials testing laboratory, paid for by the contractor, will obtain random samples of the hot mix asphalt material from behind the paving machine in accordance with Caltrans Testing Method (CTM) 125, "Methods for Sampling Highway Materials and Products in Roadway Structural Sections", to determine the Laboratory Test Maximum Density of the asphalt mixture in accordance with CTM 308.
 - d. Asphalt Concrete compaction shall be accepted based upon passing tests taken from the nuclear gauge. In the event that the nuclear gauge testing presents failing results, then core samples will be the determination for the in place density and acceptance or rejection of the compaction.
 - e. When core testing is to be performed to determine the relative compaction after nuclear gauge testing has not produced passing tests, the materials testing laboratory will obtain four 4" diameter core specimens (or four 6" diameter core specimens) for determination of relative density of the completed pavement. The four cores shall represent the sample frequency requirements specified in CTM 375.
10. Pavement at all longitudinal joints shall have a Field Density of 95%, as described in 302-5.6.2 of the Standard Specifications. When the test results of the field cores are less than 95% Relative Compaction, the Contractor shall remove a 1 foot wide section on each side of the longitudinal joint. The Contractor shall replace the removed pavement with an asphalt mix that meets the job specification at no additional cost to the Owner.

3.7 FLOOD TESTING

- A. Flood Test: Before acceptance, all pavements shall be water tested to ensure proper drainage as directed by the Inspector. The Contractor shall provide water for this purpose. The flooding shall be done by water tank truck. Depressions where the water ponds to a depth of more than 1/8-inch shall be filled or the slope corrected to provide proper drainage. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible. No standing water shall remain after 30 minutes on a 70 degree F (or warmer) day. Full compensation for complying with this requirement shall be considered as included in the Contract Unit Price for Asphalt Paving.

3.8 SEAL COAT

- A. Allow new asphalt pavement to cure 30 days before application of seal coat. See Project Specification Section 321236: Seal Coat.

3.9 FIELD QUALITY CONTROL

- A. Thickness: Tolerances for asphalt pavement thickness shall be ¼ inch, plus or minus
- B. All paving shall drain properly before being accepted. Upon completion, the pavement shall be true to grade and cross section. The asphalt substrate, shall not vary from the planned cross slope by more than +/- 0.1. When a 10 foot straightedge is laid on the finished surface of the asphalt, the surface shall not vary from the edge of the straightedge more than 1/8 inch, except at grade breaks. Where paving does not meet these tolerances, the paving material shall be repaired by a method determined by the Owner. Repairs shall not be made to pavement surface by feather-edging at the join lines. All expenses for pavement repair up shall be borne by the Contractor at NO cost to the Owner.
- C. Corrective Measures: It is the Contractor's responsibility to determine if the planarity, cross slopes, and general specifications have been met. If all of the conditions have been met the Contractor must notify the Owner in writing of the acceptance of the asphalt paving.

3.10 PROTECTION

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

3.11 CLEAN UP

- A. Clean all debris and unused materials from the paving operation. Clean all surfaces that have been spattered or defaced as a result of the paving operation. Asphalt or asphalt stains which are noticeable upon surfaces of concrete, or materials which will be exposed to view, shall be promptly and completely removed. Cleaning shall be done in a manner that will not result in any discharge of contaminated materials into any catch basin. All expenses for clean up shall be borne by the Contractor at NO cost to the Owner.

END OF SECTION

SECTION 32 12 36

SEAL COAT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Surface sealer over new asphalt paved surfaces.

1.02 REFERENCES

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("Green Book"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product information and application procedures for bituminous surfacing.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications Section 203-9, "SEALCOAT – ASPHALT BASED".
- B. Obtain materials from same source throughout.
- C. Schedule a pre-construction conference at jobsite in advance of beginning of Work. In existing areas to be seal coated and restriped, document existing striping to be duplicated before commencing seal coating work.
- D. Review and resolve conflicts involving requirements of specifications. Record discussions and furnish copies to all attendees.
- E. Beginning of Work means Contractor accepts all conditions.
- F. Agitate bulk materials during transport.

1.05 REGULATORY REQUIREMENTS

- A. Comply with local air quality management district regulations for emissions maximums.
- B. Maintain control of vehicular and pedestrian traffic during seal coating operations as required for other construction activities and in accordance with local traffic authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Seal Coat: The materials for sealcoat shall conform to Section 203-9 – “Sealcoat – Asphalt Based” of the Standard Specifications. Before incorporation in the Work, the Contractor shall submit a 2 Liter (2-quart) sample of undiluted seal coat at no cost to the Owner.

1. Seal Coat: Provide one of the following surface seals:

<u>Product Name</u>	<u>Manufacturer</u>
GuardTop	Vulcan Materials Company
Over Kote	Diversified Asphalt Product
Park Top	Western Colloid Products
Sure Seal	Asphalt Coating Engineering
MasterSeal	SealMaster Pavement Products & Equipment

PART 3 - EXECUTION

3.01 REPAIRING AND SEALCOATING OF EXISTING SURFACES

A. Preparation of Surfaces:

1. Before placing the sealcoat, the pavement surface shall be cleaned by sweeping, flushing or other means necessary to removal all loose particles of paving, all dirt, and all other extraneous material. This shall include vegetation in pavement cracks and between pavement and curb/gutter. Prior to removal an approved herbicide, which leaves behind a visible blue marker dye, shall be sprayed where vegetation exists. Surface contaminates, grease or oil spots shall be cleaned to allow for proper adhesion.
2. Prior to applying sealcoat material, cracks wider then 1/8 inch shall be cleaned, treated with weed killer, and filled with an asphalt-based crack filler (large cracks may require several applications). For best quality, it is recommended that all broken asphalt be removed and patched with new asphalt. It is also suggested that extreme low spots be filled with new asphalt. **New asphalt must cure 30 days before application of sealcoat.**
3. Immediately before commencing the sealcoat operations, all surface metal utility covers (including survey monuments) shall be protected by thoroughly covering the surface with an appropriate adhesive and oiled or plastic paper. No adhesive material shall be permitted to cover, seal or fill the joint between the frame and cover of the structure. A vertical tab shall be placed on each cover for locating after the seal application is complete. The tab shall extend at least 3” above the existing pavement surface. Covers are to be uncovered and cleaned of asphalt emulsion material by the end of the same work day. Inspector shall inspect surfaces before the installation of seal coat.

4. For best results, the asphalt, just prior to being sealed, should be sprayed with a mist of water in an amount that will leave the surface damp but with no puddles or visible water. This procedure is critical when ambient temperature is hot with bright sunlight or when the pavement is excessively aged or porous.
5. Install barricades as required to divert traffic from operations. Install temporary “no parking” signs and similar notices.

B. Application:

1. Sealcoat may be mixed with water to obtain desired consistency for job requirements to a maximum of 20% of the total volume. Care should be taken not to over dilute. Material after dilution shall be mixed with a mechanical agitator to maintain consistency and ease of application. Note that as the pavement increases in roughness, the amount of dilution should be decreased.
2. Sealcoat shall only be applied when the atmospheric temperature is greater than 55 degrees F and if rain is not forecast for the period of 24 hours after application.
3. The sealcoat material shall be applied in two applications. Unless otherwise specified, the total quantity applied (before dilution) shall be 50 gallons per 1,000 square feet.
4. Sealcoat material shall be applied using a truck-mounted tank or wheeled container in continuous parallel lines and spread by means of brooms or rubber-faced squeegees either by hand or machine and in such a manner as to eliminate all ridges, lap marks, and air pockets.
5. Hand tools shall be available in order to remove spillage. Ridges or bumps in the finished surface will not be permitted. Sealcoat material shall be homogeneous prior to spreading, with no visible separation of solids and liquids.
6. When the first coat has completely dried to the touch, apply the second coat. While misting is not normally required before second coat, surface should be clean with no foreign materials on it.

C. Drying Time:

1. Sealcoat should be allowed to dry 24 – 48 hours before permitting traffic. When asphalt is cold or in shade, or air temperature is below 75 degrees F, based on general weather, humidity and temperature conditions, drying time may need to be extended.

3.02 CLEAN UP

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

- B. Striping for parking or traffic flow should be done only after the sealcoat has thoroughly dried. It is recommended that a high quality water based Traffic Line Paint be used for best results.

3.03 PROTECTION

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

END OF SECTION

SECTION 32 13 13

CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents.
- B. The following types of concrete shall be covered in this Section:
 - 1. Portland cement concrete pavement, cement walks, flatwork, curbs, gutters, retaining curbs, swales, trash pick-up areas, ramps, mowing strips, fence post footings, sliding gate concrete, catch basins, pipe bedding and encasements, transition structures, flagpoles and light standard bases and footings, splash blocks and equipment pads.
 - 2. Portland cement concrete paving shall be stable, firm and slip resistant and shall comply with CBC sections 11B-302 and 11B-403.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Comply with the reference specifications of the GENERAL REQUIREMENTS.
- B. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("GREENBOOK"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".
- C. Comply with the current provisions of the following Codes and Standards.
 - 1. Federal Specifications:
 - a. UU-B-790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).
 - 2. Commercial Standards:
 - a. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.
 - b. ACI 301 Specifications for Structural Concrete for Buildings.
 - c. ACI 315 Details and Detailing of Concrete Reinforcement.
 - d. ACI 318 Building Code Requirements for Reinforced Concrete.

- e. ACI 347 Recommended Practice for Concrete Formwork.
- f. ACI 350 Recommended Practice for Sanitary Structure.
- g. ASTM C 31 Practices for Making and Curing Concrete Test Specimens in the Field.
- h. ASTM C 33 Specification for Concrete Aggregates.
- i. ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- j. ASTM C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete.
- k. ASTM C 42 Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- l. ASTM C 78 Specification for Flexural Strength.
- m. ASTM C 88 Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
- n. ASTM C 94 Specification for Ready-Mixed Concrete.
- o. ASTM C 114 Method for Chemical Analysis of Hydraulic Cement.
- p. ASTM C 131 Test Method for Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- q. ASTM C 136 Method for Sieve Analysis of Fine and Coarse Aggregate.
- r. ASTM C 143 Test Method for Slump of Portland Cement Concrete.
- s. ASTM C 150 Specification for Portland Cement.
- t. ASTM C 156 Test Method for Water Retention by Concrete Curing Materials.
- u. ASTM C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
- v. ASTM C 172 Specification for Sampling Fresh Concrete.
- w. ASTM C 192 Method of Making and Curing Concrete Test Specimens in the Laboratory.
- x. ASTM C 260 Specification for Air-Entraining Admixtures for Concrete.
- y. ASTM C 289 Test Method for Potential Reactivity of Aggregates (Chemical Method).

- z. ASTM C 311 Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
- aa. ASTM C 494 Specification for Chemical Admixtures for Concrete.
- bb. ASTM C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- cc. ASTM C 979 Specification for Pigments for Integrally Colored Concrete
- dd. ASTM D 1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- ee. ASTM E 119 Method for Fire Tests of Building Construction and Materials.

1.03 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with GENERAL REQUIREMENTS.
- B. The following submittals and specific information shall be provided.
 - 1. Mix Designs: Prior to beginning the WORK, the CONTRACTOR shall submit to the ENGINEER, for review, and approval, preliminary concrete mix designs for each class and type of concrete specified herein. The mix designs shall be designed by an independent testing laboratory acceptable to the ENGINEER. All costs related to such mix design shall be borne by the CONTRACTOR.
 - a. Each concrete mix submittal shall contain the following information:
 - 1) Slump on which the design is based.
 - 2) Total gallons of water per cubic yard.
 - 3) Brand, type, composition and quantity of cement.
 - 4) Brand type, composition and quantity of fly ash.
 - 5) Specific Gravity and gradation of each aggregate.
 - 6) Ratio of fine to total aggregate per cubic yard.
 - 7) Weight (surface dry) of each aggregate per cubic yard.
 - 8) Brand, type, and ASTM designation, active chemical ingredients and quantity of each admixture.
 - 9) Copy of the Building and Safety Research Report Approval for each concrete admixture.
 - 10) Air content.

- 11) Compressive strength based on 7 day and 28 day compression tests, including standard deviation calculations, corroborative data (if applicable), and required average comprehensive strength per ACI 318, Section 5.
 - 12) Time of initial set.
 - 13) Certification stamp and signature by a Civil or Structural engineer registered in state of California.
 - 14) Certificate of Compliance for Cement.
2. Certified Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall provide certified weighmaster delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the public weighmaster's signature, and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.
 3. When a water reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for concrete both with and without the admixture.
 4. The CONTRACTOR shall furnish a Certificate of Compliance signed by the supplier identifying the type of fly ash and stating that the fly ash complies with ASTM C 618 and these Specifications, together with all supporting test data prior to the use of the fly ash the sample represents. The supporting data shall also contain test results confirming that the fly ash in combination with the cement and water to be used meets all strength requirements and is compatible with air-entraining agents and other admixtures.
 5. The CONTRACTOR shall submit to the ENGINEER for review the design mix for fly ash concrete together with the design mix for portland cement (non-fly ash) concrete as specified in this Section.

1.04 QUALITY ASSURANCE

- A. Testing for Portland Cement Concrete shall be sampled and tested in accordance with the ASTM and California Tests listed in the Standard Specifications for Public Works Construction, 2015 Edition, Section 201-1.1.5.
- B. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards of concrete, or not less than once for each 2,000 square feet of surface area for slabs. 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.

- C. The cost of all laboratory tests on cement, aggregates, and concrete, will be borne by the CONTRACTOR.
- D. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the Owner, and the CONTRACTOR shall provide assistance and facilities to the INSPECTOR in obtaining samples, and disposal and cleanup of excess material.
- E. Curbs and gutters shall be staked by a Land Surveyor licensed to practice in the State of California.
- F. Job Mock-Up
 - 1. General
 - a. Make samples on-site; revise as required; obtain Architect's approval, 10 days prior to casting finished work.
 - b. Finished work to match approved samples.
 - c. Approved sample may be incorporated into the work. Retain samples until completion of all concrete work.
 - d. Include typical tooled joint control in sample.
 - 2. Broom Finished Concrete; Exterior Flatwork: Provide sample, 20 s.f. minimum area.
 - 3. "Sacked" Vertical Surface; Exterior Wall: Provide sample, 5 sf. minimum area.
- G. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 347.
- H. Construction tolerances shall not violate dimensions, grades, slopes required by CBC for accessibility requirements. Adjust work accordingly to comply with requirements.
- I. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/8-inch; In 20 feet or more: 1/4-inch
Variation from the level or from the grades shown.	In 10 feet: 1/8-inch; In 20 feet or more: 1/4-inch
Variation from the plumb	In 10 feet: 1/8-inch;

	In 20 feet or more: 1/4-inch
Variation in the thickness of slabs and walls.	Minus 1/8-inch; Plus 1/4-inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/8-inch

PART 2 - PRODUCTS

2.01 CONSTRUCTION MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.
- D. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Conform to Section 303-5.2 of the Standard Specifications.
 - 1. Use flexible or curved forms for curves of a 100-foot or less radius.
- E. Reinforcing Materials: As follows:
 - 1. Steel Reinforcing Bars: ASTM A 615 deformed grade 40 billet steel, plain finish, unless otherwise specified on Construction Document. Fabrication, sampling and jobsite handling shall conform to the requirements in ASTM Designation: D 3963, except the 2 samples shall be 30 inches long.
 - 2. Dowels:
 - a. Dowel bars shall be plain round smooth conforming to the requirements in ASTM Designation: A 615/A 615M, Grade 40 except that the two samples required in ASTM Designation: D 3963/D 3963M shall be 18 inches long. Dowel bars shall be free from burrs or other deformations detrimental to free movement of the bars in the concrete
 - b. Dowel bars shall be lubricated with a bond breaker over the entire bar. A bond breaker application of petroleum paraffin based lubricant or white-pigmented curing compound shall be used to coat the dowel bars completely prior to placement. Oil and asphalt based bond breakers shall not be used. Paraffin based lubricant shall be Dayton Superior DSC BB-Coat or Valvoline Tectyl 506 or an approved equal. Paraffin based lubricant shall be factory applied. White pigmented curing compound

shall conform to the requirements of ASTM Designation: C 309, Type 2, Class A, and shall contain 22 percent minimum nonvolatile vehicles consisting of at least 50 percent paraffin wax. Curing compound shall be applied in 2 separate applications, the last application not more than 8 hours prior to placement of the dowel bars. Each application of curing compound shall be applied at the approximate rate of one gallon per 15 square yards.

3. Epoxy for bonding tie bars and dowel bars to portland cement concrete shall be a two-component, epoxy-resin, conforming to the requirements of ASTM Designation: C 881, Type V, Grade 3 (Non-Sagging), Class B or C. The class used shall be dependent on the internal temperature of the hardened concrete at the time the epoxy is to be applied. Class B shall be used when the internal temperature is from 40 °F to 60 °F. Class C shall be used when the internal temperature is above 60 °F, but not higher than recommended by the manufacturer. A copy of the manufacturer's recommended installation procedure shall be provided to the Engineer at least 7 days prior to the start of work. Epoxy shall be applied in conformance with the manufacturer's recommendations.
 - a. Simpson Strong-Tie Set-XP Epoxy Adhesive (or approved equal) ICC-ES ESR-2508.

F. Concrete Materials: As follows:

1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type II. Portland cement shall contain not more than 0.60 percent alkalis. The term "alkalis" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114. A single brand of cement shall be used throughout the work, and prior to its use, the brand shall be acceptable to the ENGINEER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the INSPECTOR.
2. Concurrent with strength design criteria, concrete shall also be proportioned to provide the requisite durability to satisfy the exposure conditions imposed by either environment and/or service. Durability, in this context, refers to the ability of the concrete to resist deterioration from the environment or service in which it is placed. Concrete proportioned in accordance with ACI 318, chapter 4, Durability Requirements, will meet this criteria.
3. Combined Aggregate: 1" maximum coarse aggregate size conforming to Grading C of Standard Specifications Section 201-1.3.2(A). Aggregates shall be obtained from pits acceptable to the INSPECTOR, shall be non-reactive, and shall conform to ASTM C 33.

4. Water: Shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.
 5. ***“Pea gravel” mix is not acceptable***, unless specifically approved in writing by the Civil Engineer of Record prior to construction.
- G. Admixtures:
1. The ENGINEER may require the use of admixtures or the CONTRACTOR may propose to use admixtures to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the CONTRACTOR's expense. The use and continued use of an admixture shall be approved by the ENGINEER. Admixtures specified herein, other than calcium chloride, shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.
 2. These admixtures shall not be used in greater doses than those recommended by the manufacturer or permitted by the ENGINEER. The permitted dosage of the admixture shall not exceed that which will result in an increase in the driving shrinkage of the concrete in excess of 20 percent when used in precast or prestressed concrete, or 10 percent when used in any other structural concrete. The strength of concrete containing the admixture in the amount of proposed shall, at the age of 48 hours and longer be not less than that of similar concrete without the admixture. The admixture shall not adversely affect the specified air content, unless permitted by the ENGINEER.
 3. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as [Sika Chemical Corporation's Plastiment], [Master Builder's Pozzolith 300R], or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a set accelerating admixture such as [Sika Chemical Corporation's Plastocrete 161FL], [Master Builder's Pozzolith 50C], or equal shall be used.
 4. Low range water reducer shall conform to ASTM C 494, Type A. It shall be either a hydroxylated carboxylic acid type or a hydroxylated polymer type. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
 5. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G.
 - a. If the high range water reducing agent is added to the concrete at the batch plant, it shall be second generation type, [Daracem 100, as

manufactured by W.R. Grace & Co.]; [Pozzolith 430R, as manufactured by Masterbuilders]; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.

- b. If the high range water reducer is added to the concrete at the job site, it shall be used in conjunction with a low range water reducer and shall be [Pozzolith 400N and Pozzolith MBL82, as manufactured by Masterbuilders]; [WRDA 19 and WRDA 79, as manufactured by W.R. Grace & Co.]; or equal. Concrete shall have a slump of 3-inches \pm 1/2-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
- 6. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 4 percent; provided that, when the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one day, the total air content provided shall be 5 to 6 percent. The Owner reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
 - 7. Calcium Chloride: Except as otherwise provided herein, calcium chloride will not be permitted to be used in concrete.
 - 8. Fly ash/pozzolan shall conform to ASTM C 618 and the following supplementary requirements:
 - a. Class F fly ash
 - o Loss on ignition, maximum 4 percent
 - o SO₃ content, maximum 3 percent
 - o Moisture content, maximum 1 percent
 - b. Class F fly ash, as a percent by weight of total cementitious material, shall not exceed 20 percent
 - c. When Sulfate Resistant or Special Exposure Concrete is specified, test results shall be submitted to the Engineer as specified in Section 2-5.3 of the Standard Specifications. The test result shall show that the fly ash to be used is effective in contributing to sulfate resistance in conformance with ASTM C618, Table 3 (optional physical requirements) as tested in accordance with ASTM C 1012. The data submitted shall be less than 6 months old.

H. Curing Materials:

1. Concrete curing compound shall conform to the requirements of ASTM C309 Type 1-D (clear or translucent with a fugitive dye), Class B (Resin Type Only), except the loss of water shall not exceed 0.15 kilograms per square meter in 24 hours nor 0.45 kilograms per square meter in 72 hours when tested in accordance with ASTM C 156. The CONTRACTOR shall provide, when requested by the ENGINEER, certified copies of vendor's test report showing compliance with ASTM C 309 and these specifications. The testing and the report shall be supplied without cost to the Agency. All compounds shall be furnished by the CONTRACTOR in sealed original containers labeled in accordance with ASTM C 309 and with the date of manufacture.
 2. Polyethylene sheet for use as concrete curing blanket shall be white and conform to ASTM C 171. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
 3. Polyethylene-coated burlap for use as concrete curing blanket shall conform to ASTM C 171. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.
- I. Expansion Joint Filler Material
1. Curb & Gutter: Nonextruding and Resilient Filler: Celotex "Flexcell", or approved equal, 1/4-inch thick material conforming to ASTM D 1751.
 2. Concrete Walk and Slab: Joint filler material shall be preformed expansion joint filler conforming to the requirements of ASTM D994. A Certificate of Compliance for the joint filler material shall be furnished to the Engineer. The certificate shall be accompanied with a certified test report of the results of the required tests performed on the joint filler material within the previous 12 months prior to proposed use. The certificate and accompanying test report shall be provided for each lot of joint filler material prior to use on the project.
 3. Silicone Joint Sealant: Premium-grade, high-performance, moisture-cured, single-component, polyurethane-based, non-sag elastomeric sealant. Meets Federal specification TT-S-00230C. Meets ASTM C-920, Type S, Class 25 or 35; Grade NS, Use T or NT, Shore A Hardness (21 day) 35-45. A Certificate of Compliance for the silicone sealant shall be furnished to the Engineer. The Certificate shall also be accompanied with a certified test report of the results of the required tests performed on the sealant material within the previous 12 months prior to proposed use. The Certificate and accompanying test report shall be provided for each lot of silicone joint sealant prior to use on the project.
 - a. Sika Corporation, Sikaflex-1A.
 - b. Tremco, Inc., Dymonic.
 - c. Tremco, Inc., Vulkem 116.

- d. Bostik Construction Products Div., Chem-Calk 900.
- J. Concrete Sealer: For natural color concrete only, HLQ-125 as manufactured by SINAK Corp., San Diego, CA (619/231-1771), HLQ-125 as manufactured by SINAK Corp., San Diego, CA (619/231-1771), or equivalent product of another manufacturer in accordance with the "or equal" provision of the Contract Documents, penetrating sealer that interacts with mineral compounds and siliceous materials in portland cement concrete to produce more dense, non-dusting surface.
- K. Related Materials: As follows:
 - 1. Damp-proofing agent shall be an asphalt emulsion, such as [Sonneborn Hydrocide 660], [Flintkote C-13-E Foundation Coating], or equal.
 - 2. Epoxy adhesives shall be the following products for the applications specified:
 - a. For bonding freshly-mixed, plastic concrete to hardened concrete, [Sikadur Hi-Mod Epoxy Adhesive, as manufactured by Sika Chemical Corporation]; [Concresive 1001-LPL, as manufactured by Adhesive Engineering Company]; or equal.
 - b. For bonding hardened concrete or masonry to steel, [Colma-Dur Gel], [Sikadur Hi-Mod Gel], or equal.
- L. Flatwork, Curbs / Curb & Gutter Mix Design: At a minimum, concrete for flatwork, curbs and curbs & gutters shall conform to the Standard Specifications for Public Works Construction, Section 201-1.1.2, mix class 560-C-3250:
 - 1. Compressive Strength: minimum of 3,250 psi at 28 days compressive strength.
 - 2. Slump Limit: 4 inches at point of placement.
 - 3. Cement per cu yard (sacks): 6.0 (minimum).
 - 4. Air Content: 4% +/- 1% percent.
- M. Slurry Mix Design:
 - 1. Compressive Strength: 200 psi at min. 28 days compr. strength.
 - 2. Slump Limit: 5 inches at point of placement.
 - 3. Cement per cu yard (sacks): 2.0
 - 4. Aggregate Gradation: "E" per S.S.P.W.C. table 201-1.3.2(A).

PART 3 - EXECUTION

3.01 PREPARATION OF SURFACES FOR CONCRETING

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the

time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

- B. Subgrade Preparation:
 - 1. See project soils report section 4.1.2 for subgrade preparation requirements.
- C. The compacted surface shall be firm, hard and unyielding. The term "firm, hard and unyielding" as used in S.S.P.W.C. Section 301-1.3 shall mean that when the heaviest construction and hauling equipment used on the project drives over the subgrade, no permanent deformation shall occur either before or during pavement construction. On areas where the underlying material appears to be wet or soft, or where it deflects under wheel loads, the Contractor shall employ excavation and work techniques which do not worsen the subgrade condition.
- D. The above subgrade preparation recommendations are based on the assumption that soils encountered during field exploration are representative of soils throughout the site. However, there can be unforeseen and unanticipated variations in soils between points of subsurface exploration. For this reason, the actual scarification or over-excavation depths will have to be determined on the basis of in-grading observations and testing performed by representatives of the project geotechnical consultant.
- E. A California Licensed Surveyor (LS) must provide grade stakes and elevations for the Geotechnical Engineer to verify that the over-excavation depths, shown on the construction drawings for concrete pavement structural sections, have been achieved prior to re-compaction.
- F. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the ENGINEER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- G. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and ACCEPTED by the INSPECTOR at least 24 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- H. All inserts or other embedded items shall conform to the requirements herein.
- I. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the INSPECTOR before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.

- J. Where concrete is to be cast against old concrete, (greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand-blasting, exposing the aggregate. In concrete shear-walls, suspended slabs and roof slabs, the interface surface at construction joints shall be roughened to a full amplitude of one quarter inch. The hardened surface shall be cleaned of all latent foreign material and washed clean, prior to the application of an epoxy bonding agent.
- K. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.
- L. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- M. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- N. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- O. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.02 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of ACI 301 and the requirements of this Section.
- B. The total elapsed time between the addition of water at the batch plant and the completion of the discharge of the P.C.C. from the mixer shall not exceed 90 minutes. All P.C.C. remaining in the mixer after said 90-minute time limit shall be rejected and removed from the project site.
- C. Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the CONTRACTOR.
- D. Whenever batch trucks or other paving equipment cause rutting of the subgrade or subbase in concrete placement areas, inspectors shall immediately stop construction.

Construction shall not be allowed to resume until distorted subgrade or subbase is repaired. Contractors and inspectors should locate by proof rolling, any questionable unstable areas in advance to avoid distortion under equipment. Wet, unstable areas must be dried out or replaced before starting placement of asphalt. Locating wet or soft areas in advance can be accomplished by testing finished subgrade or subbase with a loaded truck. Construction of concrete pavement should not proceed unless testing gives a reasonable indication that distortions will not occur during construction of overlying pavement. When repair, aeration, and recompaction are required to correct damage from Contractor's operation, all necessary repair will be done at Contractor's expense. However, if the Engineer determines that additional depth of aeration and recompaction are needed, that should be paid by change order.

- E. All pull boxes, meter boxes, valve covers and manholes shall be adjusted to proposed finish grade prior to placement of the P.C.C.
- F. Dowel Placement:
 - 1. Dowel bars shall be centered on the joint within a tolerance of ± 2 inches in the longitudinal direction directly over the contact joint or sawcut for the transverse weakened plane joints, as shown on the plans. Prior to placement of dowel bars, the Contractor shall submit to the Engineer a written procedure to identify the transverse weakened plane joint locations relative to the middle of the dowel bars and the procedure for consolidating concrete around the dowel bars.
 - 2. Dowel bars shall be placed at longitudinal joints as shown on the plans. Dowel bars shall be placed as shown on the plans by using mechanical insertion. When dowel bars are placed by mechanical insertion, the concrete over the dowel bars shall be reworked and refinished so that there is no evidence on the surface of the completed pavement that there has been any insertion performed. When drill and bonding of dowel bars is performed at contact joints, a grout retention ring shall be used.
- G. Concrete shall not be placed until the forms and reinforcement have been inspected, all preparations for the placement have been completed, and the preparations have been checked by the project inspector, all subject to the observation of the engineer or architect.
- H. Casting New Concrete Against Old: An approved epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations. This provision shall not apply to joints where waterstop is installed.
- I. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the INSPECTOR. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will

be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

- J. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
- K. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.
- L. Cold Weather Placement: Earth foundations shall be free from frost or ice when concrete is placed upon or against them. Fly ash concrete shall not be placed when the air temperature falls below 50 degrees F.
- M. A transverse construction joint shall be constructed, including dowel bars, at the end of each day's work or where concrete placement is interrupted for more than 30 minutes, to coincide with the next contraction joint location. If sufficient concrete has not been mixed to form a slab to match the next contraction joint, when an interruption occurs, the excess concrete shall be removed and disposed of back to the last preceding joint. The cost of removing and disposing of excess concrete shall be at the Contractor's expense. Excess material shall become the property of the Contractor and shall be disposed of. A metal or wooden bulkhead (header) shall be used to form the joint. The bulkhead shall be designed to accommodate the installation of dowel bars.
- N. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. The finished surface shall be free from humps, sags, blemishes or other irregularities Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
- O. Broom Finish Type:
 - 1. Surfaces Sloped Less than 6%: Provide a medium salt (medium broom) finish by drawing a soft bristle broom across concrete surface, perpendicular to line of traffic, to provide a uniform fine line texture.

2. Surfaces Sloped greater than 6%: Provide a slip resistant (heavy broom finish) by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

P. Joints:

1. Joints: Joints in concrete curb, gutter, and walk shall be designated as expansion joints and control joints. Joints for concrete flatwork shall be provided every five (5) feet or less. Expansion joints for swales, curbs / curb & gutter shall be placed at no greater than 15 feet on center or as indicated on construction drawings.

- a. Expansion Joints: Provide 1/2" premolded joint filler, material meeting Section 2.01I herein. Construct expansion joints in conformance with Standard Specification Section 303-5.4.2 and the details on the construction documents.

- 1) Extend expansion joint fillers full-width and depth of joint, and 1/4" below finished surface where joint filler is indicated. If no joint sealer is called for, place top of premolded joint filler flush with top of concrete or curb.
- 2) Where silicone joint sealer is noted on the construction documents, the premolded joint filler strips shall be placed 1" below the surface of the concrete or curb, the full width of the expansion joint. The remainder of all joints shall be filled to within 1/4" below the surface of the concrete with the silicone joint sealant.
- 3) Provide expansion joint filler strips, with elastomeric sealer, between p.c.c. walk and curb, p.c.c. walk and buildings, & p.c.c. walk and retaining walls and at locations noted on the construction documents. The depth of the filler strip shall be the depth of the p.c.c. walk plus 1 inch with the top set flush with the specified grade of the top of curb or walk.

- b. Control Joints:

- 1) Control joints in site work concrete shall comply with Standard Specification Section 302-6.5.4, except that the configuration of the joint, shall be as indicated on the construction documents.
- 2) Control joints in concrete curbs, sidewalks and gutters shall comply with Standard Specification Section 303-5.4.3, except that the joint configuration shall be as indicated below.
- 3) Location: As shown on construction documents. In swales and gutters, including gutter integral with curb, joints shall be at regular intervals not exceeding 10 (10) feet. Where integral

curb and gutter is adjacent to concrete pavement, the joint shall be aligned with the pavement joints where practical.

- Q. Protection: In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control film. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.

3.03 LIGHT STANDARD BASES, FLAGPOLE BASES, POST BASES AND SIMILAR SITE STRUCTURES

- A. Forms: Suitable material and type, size, shape, quality and strength to insure construction as designed, true to line and sufficiently rigid to resist deflection during placing of concrete. Clean forms of all dirt, mortar and foreign matter before use.
- B. Reinforcement: Place accurately and hold in position, using metal chairs, spacers, metal hangers, supporting wires and other devices of sufficient strength to resist crushing under full load. Clean reinforcing steel of mortar, oil, dirt, loose mill scale loose or thick rust and coatings.
- C. Coordinate installation of conduits, cast in place items and other inserts.
- D. Finish: Grind or sack as required as determined by the Architect to produce a smooth, straight, plumb and acceptable finish without burrs or form marks. For horizontal surfaces: provide float finish.
- E. Curing: Cure surfaces utilizing one of the following methods:
1. Spraying: Spray water over slab areas and maintain wet for 7 days.
 2. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
 3. Apply liquid curing compound at rate of 200 square feet per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units or finish of any kind.

3.04 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and

rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.

- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.05 CURING

- A. Comply with 2016 California Building Code, Title 24, Part 2, Volume 2, Section 1905A.
 - 1. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven (7) days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by curing as herein specified.
 - 1. Provide moisture-curing by the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.
 - 2. Provide curing and sealing compound to exposed exterior slabs, walks, and curbs, as follows:
 - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Re-coat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - b. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid, floor hardener, waterproofing, dampproofing, membrane roofing, flooring

(such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.

- C. Concrete slabs and paving shall be properly cured and protected against damage and defacement of nature during construction operations. If weather is hot or surface has dried out, spray surface with fine mist of water starting not later than two hours after final troweling. Surface of finish shall be kept continuously wet for at least ten days. Wetting is considered emergency work and shall be performed on weekends and holidays if necessary.
- D. Concrete Sealer Application: Apply specified concrete sealer in continuous operation in accordance with manufacturer's instructions and recommendations.
 - 1. Prior to starting application, protect adjoining Work, including sealant bond surfaces, from spillage or blow-over of concrete sealer.
 - a. Cover adjoining and nearby surfaces of aluminum and glass where there is the possibility of the concrete sealer being deposited on surfaces.
 - b. Cover live plants and grass.
 - c. Immediately clean concrete sealer from adjoining surfaces, complying with manufacturer's cleaning recommendations.
 - 2. Apply concrete sealer under temperature conditions according to manufacturer's instructions.
 - 3. Apply concrete sealer in light, even coats using garden sprayer, airless sprayer or paint brush.
 - 4. Apply concrete sealer at rate to suit porosity of portland cement concrete but not less than no more than coverage rates recommended by manufacturer for effective sealing of surface.
- E. Integrally Colored Concrete: Apply curing and sealing compound for integrally colored concrete according to manufacturer's instructions using manufacturer's recommended application techniques. Apply curing and sealing compound at consistent time for each pour to maintain close color consistency.
 - a. Curing compound shall be same color as the colored concrete and supplied by same manufacturer of the colored admixture.
 - b. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 *Plastic Shrinkage Cracking* published by the National Ready Mixed Concrete Association.
 - c. Do not cover concrete with plastic sheeting.
- F. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the

Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR'S expense. Exclude traffic from concrete paving for at least 7 days after placement.

- G. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

3.06 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment: The pumping equipment must have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be 4-inches.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete will not be permitted.
- F. Proportioning: Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified herein.
- G. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.
- H. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
- I. Water and slump requirements shall conform to the requirements of this Section.
- J. Cement and admixtures shall conform to the requirements of this Section.
- K. Field Control: Concrete samples for slump per ASTM C 143 and test cylinders per ASTM C 31 and C 39.

3.07 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to

be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced.

1. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair purposes shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-shrink grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with non-shrink grout.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to filling any structure with water, all cracks that may have developed shall be repaired to the satisfaction of the ENGINEER. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.
- F. The finished surface shall be free from humps, sags, blemishes or other irregularities.

3.08 FIELD QUALITY CONTROL

- A. Correction of Mix Design for Failed Concrete Tests: If the compressive cylinder strength test for in place PCC yields test results below the specified 28-day PCC compressive strength and the Engineer determines a corrective change is necessary, the Contractor shall, at its own expense, make corrective changes in the mix proportions. The Engineer

shall approve the changes in the mix proportions or PCC placement procedures, before any additional PCC is placed on the job.

- B. Flood Tests: Before final acceptance, and after concrete has thoroughly cured, all concrete pavement, including swales and curb & gutter, shall be water tested to ensure proper drainage as directed by the Inspector. The Contractor shall provide water for this purpose. The flooding shall be done by water tank truck. Concrete work where water ponds and does not run off in a reasonable amount of time (1-hour), shall be removed to the nearest score or joint line and replaced to provide proper drainage. Full compensation for complying with this requirement shall be considered as included in the Contract Unit Price for cement concrete pavement.

3.09 CARE AND REPAIR OF CONCRETE

- A. General: The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR'S expense.
- B. The contractor shall barricade and protect placed Portland Cement Concrete from all damage, marks, mars and/or graffiti. Any Portland Cement Concrete damaged, defaced, discolored or defective shall be replaced at the contractor's expense.

END OF SECTION

SECTION 32 13 16

DECORATIVE CONCRETE PAVING

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 colored and natural gray retardant finish concrete paving, concrete stairs, ramps, curbs and gutter and concrete bands, headers and finish for concrete site walls.
- B. Related Sections:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Section 07 92 00 "Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and asphalt paving or adjacent construction.

1.3 SUBMITTALS

- A. See section 01 33 00 – Submittal Procedures, for submittal procedures.
- B. Product Data:
 - 1. For each type of product indicated submit manufacturer's product data, specifications, typical installation details and other data to demonstrate compliance with the specified requirements for all manufacturer products.
 - 2. Statement of Mix Design: Submit (3) copies of Statement of Mix Design prepared by batch plant servicing Project for each load delivered to Project. Statement of Mix Design to contain following information:
 - a. Name, address, and telephone number of batch plant preparing statement of mix design.
 - b. Date of mix design.
 - c. Project location.
 - d. Contractor requesting load delivery.
 - e. Mix design number.
 - f. Integral color used.
 - g. Gradations for sand and aggregate.
 - h. Material weights, specific gravity, and absolute volumes.
 - i. Basis of testing, i.e. ASTM C-94, ASTM C-150, ASTM C-33.
 - j. Water/cement ratio.
 - k. PSI rating.

- l. Signature of testing laboratory manager.
 - m. Signed stamp from registered Project structural engineer or architect LEED Submittals.
 - C. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
 - D. Samples for Verification: To be determined by the mock-ups.
 - E. Shop Drawings:
 - 1. Indicate layout of joints.
 - 2. Submit shop drawings for reinforcing steel and accessories in accordance with ACI standards.
 - 3. Paving Jointing and Pour Sequence Plan - submit three full size bond prints of each paving sheet indicating the following:
 - a. Proposed layout of contraction, construction and isolation joints. Clearly delineate the three different joint types.
 - b. Layout of paving types as indicated on Drawing Paving Schedule. Give overall dimensions of each paving type.
 - c. Concrete pour sequence. Indicated sequence of paving pour installation.
 - F. Qualification Data: For qualified Installer.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.

8. Joint fillers.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm and individuals trained and approved by manufacturer of decorative concrete paving systems with a minimum of fifteen consecutive years' experience. Provide written evidence to indicate successful experience in installing Intecrete or equivalent architectural concrete paving, or similar, on at least (5) projects with a combined installed square footage of at least 75,000 SF with (3) projects located within a 100 mile radius of Project site.
- B. ACI Certified Personnel:
 - 1. Concrete Flatwork Finisher:
 - a. Minimum of 1,500 hours of field experience having installed at least (5) projects containing Intecrete® architectural concrete paving.
 - b. Must be present during important stages of concrete production such as layout, formwork, or concrete placement and finishing.
 - c. Project must have a minimum of (1) ACI certified Concrete Flatwork Finisher at important phases of production.
 - d. Submit verification of current ACI certification.
 - 2. Concrete Flatwork Technician:
 - a. Minimum of (1) ACI certified Concrete Flatwork Technician able to render technical assistance on project, if requested.
 - b. Submit verification of current ACI certification.
- C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- E. Source Limitations: Obtain decorative concrete paving products and each type or class of cementitious material of the same brand from same manufacturer's plant, and obtain each aggregate from single source.
- F. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- G. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

H. Mockups:

1. Prepare on-site paving and stair mock-ups as follows:
 - a. Prepare a minimum 8-foot square mock-up of each different paving type specified on Drawings. Label mock-ups (preferably on vertical side of mock-up) with specified paving type to facilitate mock-up review.
 - b. Construct mock-ups using identical concrete mix design, products, jointing, and methods of overall workmanship that will be employed during production.
 - c. Ensure that same crew preparing mock-ups will be responsible for production work.
 - d. Construct mock-ups in a protected location approved by Owner. Ideally mock-ups should be located as close to production work as possible to facilitate comparison review and be located in a sunny location.
 - e. Approved mock-ups will be used as standard for future production work review and assessment. Owner should be prepared to physically sign mock-up using a permanent black marker to attest Owner's approval of mock-up. Rejected mock-ups can remain on-site until removal of approved mock-ups is required.
 - f. Original 6-inch or 12-inch concrete samples, if they were prepared for this project, will not be used in future production paving review once mock-ups have been approved.
 - g. Owner will incur costs to redo mock-ups if Owner requires design changes during mock-up review. Contractor will incur costs to redo mock-ups if Owner rejects mock-ups due to Contractor error such as incorrect concrete mix design or unacceptable appearance.
 - h. Protect approved mock-ups from damage during course of Work.
 - i. i. Clean mock-ups prior to Final Walkthrough for Acceptance to facilitate unencumbered comparison review by Owner between approved mock-ups and production work.
 - j. k. Remove mock-ups from site when directed by Owner.
2. Prepare site wall mock-ups as follows:
 - a. Minimum 5-foot long mock-up of each specific Wall type indicated on Drawings.
 - b. Construct mock-ups using products, materials and workmanship methods identical to those that will be employed during production. Workmanship to exhibit finish, jointing, and edging.
 - c. Use same concrete mix that will be used during production.
 - d. Ensure that same personnel that prepared mock-ups will also install production work.
 - e. Construct mock-ups in a location approved by General Contractor.
 - f. Approved wall mock-ups will be standard for assessment for future production work.
 - g. Construct additional mock-ups at Contractor's expense if workmanship is responsible for mock-up rejection by Owner, however, Owner will incur costs to redo mock-up if Owner requests design changes during mock-up preparation.
 - h. Protect approved mock-ups during course of Work.
 - i. Remove mock-ups from site when directed by General Contractor.

I. Preinstallation Conference: Conduct conference at Project site.

1. At least three weeks prior to ordering specified materials or the start of concrete work,
2. Arrange a pre-installation meeting between the Contractor, Architect, Project superintendent, concrete supplier, and concrete finisher to review finishing techniques of
3. Concrete, use of additives, application of curing compounds and coordination with other
4. trades.

1.7 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FLAT WORK FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves of a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.
- B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 FORM MATERIALS

- A. Plywood:
 1. Exterior grade plywood panels, non-absorptive, providing a continuous, true, and smooth surface such as medium-density overlay (MDO), Class 1, or better, with mill-applied release agent and sealed edges.
 2. Form Joint Tape: Pressure-sensitive compressible foam tape.
 3. Form-Release Agent: Colorless form-release agent that will not bond with concrete surface or impair subsequent treatments of those surfaces.
- B. Structural:
 1. #2 Construction Grade S4S Douglas Fir minimum 1-1/2-inches thick, free of warping, loose knots, cupping, checks, bows, cracks, and other imperfections that would produce objectionable defects in finished work.
 2. Depth of forms to be same depth as concrete being placed.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: Grade 60 steel conforming to ASTM A615 and free of rust, dirt, grease or oils.
- B. Steel Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A1064/A1064M and free of rust, dirt, grease or oils.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.
- D. Steel Bar Mats:
 - 1. Grade 60 deformed steel bars assembled with clips conforming to ASTM A184 and free of rust, dirt, grease or oils.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, gray portland cement Type III or Type V. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F. Fly Ash content not to exceed 25% total concrete weight.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Aggregate Size: 1 inch (25 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
- F. Liquid Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Davis Colors.
- b. Admixtures Inc.
- c. Scofield, L. M. Company.
- d. Solomon Colors, Inc.

2.5 CURING AND SEALING MATERIALS

- A. Amber, Aliphatic, Membrane-Forming Curing and Sealing Compound; manufactured for use with colored concrete.
 1. Admixtures Inc; Colorfull Clear Curing Compound.
 2. 1100-Clear by WR Meadows; www.wrmeadows.com.

2.6 RELATED MATERIALS

- A. Fine and Coarse Aggregate: Clean, hard, and durable washed concrete sand conforming to ASTM C33. Use same fine aggregate from single source throughout duration of Project. Refer to Paving Schedule on Drawings for sizing of coarse aggregate. Some paving types may require different coarse aggregate sizes
- B. Joint Fillers: ASTM D 5249, Type 2, flexible foam expansion joint in preformed strips.
 1. Products: W.R. Meadows; Seal Tight Cermar.
- C. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).
 1. ACC; Optimus.
 2. Grace, Topcast.

2.7 JOINT MATERIALS

- A. Construction Joints:
 1. Steel Slip Dowels: 5/8-inch-diameter smooth steel bars, free of dirt, grease, and oils.
 2. Plastic Dowel Sleeves: Encase 50 percent of each dowel in a Speed Dowel® plastic alignment sleeve to allow parallel lateral movement of each dowel.
 - a. Acceptable Manufacturers:
 - 1) Speed Dowel® by Greenstreak Group; www.greenstreak.com.

2.8 CONCRETE SEALER

- A. Low sheen, low VOC, penetrating sealer that exhibits superior resistance to stains, spills, and other contaminates.
- B. Acceptable Manufacturers:
 1. Repello® by Scofield; www.scofield.com.
 2. Siloxene PD® by Prosoco; www.prosoco.com.
 3. 511 Impregnator by Miracle Sealants; www.miraclesealants.com.

PART 3 - EXECUTION

3.1 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 2800 psi.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: 5 inches (125 mm). plus or minus 1 inch (25 mm).
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing and retarding admixture in concrete as required for placement and workability.
- E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. M)
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

3.2 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

3.3 SUBGRADE

- A. Subgrade to meet requirements of project's Geotechnical report.
- B. Water condition subgrade and compact to 90 percent relative compaction is placed over prior to placing concrete.
 - 1. Screed subgrade to a smooth plane.
 - 2. Ensure that utilities, including irrigation lines are buried and compacted.

3. Keep subgrade damp prior to placing concrete.

3.4 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below decorative concrete work to identify soft pockets and areas of excess yielding.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.6 FORMWORK

- A. General:
 1. Construct forms accurately to dimensions, plumb and true to line and grade.
 2. Use forms that are strong, mortar tight, braced and tied so as to maintain position and shape during placing of reinforcing and concrete.
 3. Wavy surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will be rejected.
 4. Carefully verify and check forms for alignment and level as the Work proceeds.
 5. Make needed adjustments or add additional bracing prior to pouring concrete.
- B. Formwork Material at Exposed Surfaces: Smooth metal, resin-coated plywood, or high-density overlay plywood which will provide an ultra-smooth surface.
- C. Tolerances for Exposed Concrete:
 1. Top of form units shall not vary more than 1/8 inch from a 10 feet long straight edge.
 2. Vertical faces shall not vary more than 1/8 inch from a 10 feet long straight edge.
- D. Joints:
 1. Construct forms and assemble them in such a manner so that joints occur at accepted locations.
 2. Seal joints to prevent leakage and provide exposed finish surfaces free of joint marks or any indication of where the form joints occurred.
- E. Corners:
 1. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to face of concrete.

2. Form exposed corners to produce square smooth, solid unbroken lines, unless indicated otherwise.
- F. Other Trade Requirements:
1. Construct chases, slots and recesses as required.
 2. Locate inserts, anchor plates and other items to be embedded in concrete where required, properly place and securely anchor.
- G. Recesses and Openings: Provide as shown on the Drawings.
- H. Prior to Pouring Concrete:
1. Thoroughly clean out forms to be used.
 2. Thoroughly wet wood forms where form coatings are not used.
- I. Removal of Forms:
1. Do not remove supporting forms or shoring until concrete has sufficient strength to carry its own weight and other loads upon it.
 2. Remove forms only after concrete has attained at least 50% of its design compressive strength.
- J. Re-use of Forms:
1. Do not reuse if there is any evidence of surface wear or tear which would impair quality of exposed finishes.
 2. Store formwork and form materials in such a manner as to prevent damage or distortion.
 3. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage to concrete finish.

3.7 REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap to adjacent mats.

3.8 FORM TIES

- A. Exposed form ties will not be visible once the concrete wall is architecturally finished, however, form ties will still be required to construct wall.

- B. Internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete upon removal. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2-inches from the architectural concrete surface.
- C. Form ties to have a minimum working strength when fully assembled of at least 3,000 lbs.
- D. Adjust form ties in length so as to permit complete tightening of forms and of such type as to lean no metal closer than 1-inch to an exterior surface or closer than ½-inch to an interior surface.
- E. Do not fit form ties with lugs, cones, washers, or other device so as to act as a spreader within forms, or for other purposes that will leave a hole or depression larger than 7/8-inch in diameter back of exposed surface of concrete.
- F. Do not use wire or wood ties.
- G. Coat ties that are to be pulled from walls with cup grease or other approved material to facilitate efficient removal.
- H. Loosen tie rods that are to be entirely removed from walls 24 hours after concrete is poured. Remove all but a sufficient number of ties to hold forms in place.

3.9 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Dowelled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion as indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3/16-inch- (5-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
1. Perform jointing with a new diamond tip circular saw.
 2. Joint Width: Per Drawings. Do not exceed 3/16-inch in width.
 3. Depth of sawcuts: 1/4th depth of slab.
 4. Sawcut joints in a straight line complete with no overcutting.
 5. Use a hand tool to sawcut up to vertical edges such as walls, steps, curbs and columns. No over cutting into vertical surfaces will be allowed.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.10 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- C. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
- D. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side

forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

- G. Screed paving surface with a straightedge and strike off.
- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.11 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
- C. Broom Finish:
 - 1. Prior to brooming, provide a floated finish.
 - 2. While the surface is still plastic, provide a uniform, broom-texture finish by pulling a fiber-bristle broom uniformly over the surface.
 - 3. Broom sidewalk paving along street in direction 90 degrees to street curb.
 - 4. Broom Service Area paving in direction 90 degrees to building walls.
 - 5. Provide texture to match the accepted mock-up finish.

3.12 RETARDANT CONCRETE FINISH

- A. Concrete Finish; after final floating:
 - 1. Retardant Finish: Roll with roller tamper and then immediately bullfloat in both directions. Immediately after initial floating, towel smooth with no indentions, apply retardant when surface has sufficient moisture in the surface.
 - 2. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 - 3. Provide texture to match the accepted mock-up finish.

3.13 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Begin curing after finishing concrete but not before and applying retardant finish.
- C. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch (19 mm).
 - 2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
 - 3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/8 inch (3 mm).
 - 4. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
 - 5. Vertical Alignment of Dowels: 1/4 inch (6 mm).
 - 6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
 - 7. Joint Spacing: 1/8 inches (3 mm).
 - 8. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
 - 9. Joint Width: 1/16 inches (1.5 mm).

3.15 FIELD QUALITY CONTROL

- A. Strength of each concrete mixture will be satisfactory if 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 (3.4 MPa).
- B. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- C. Decorative concrete paving will be considered defective if it does not pass tests and inspections.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.16 STAINING AND SEALING

- A. Allow Stratified or Sedimentary™ to dry sufficiently before applying specified stain or sealer.
- B. Do not apply sealer if air temperatures are below 50 degree F or above 90 degrees F.
- C. Once the concrete surface has been sealed, protect surface until fully dried.
- D. Follow manufacturer's directions for stain or sealer application.

3.17 REPAIRS AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 16

SECTION 32 15 31

DECOMPOSED GRANITE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section includes decomposed granite, and the following:
1. Sub-grade Preparation
 2. Base Preparation
 3. Stabilizer Application
 4. Compaction
 5. Cleanup
- B. Related work:
1. Section 31 20 00: Earthwork
 2. Section 32 90 00: Landscape Planting
- C. Definitions: The word Architect as used herein shall refer to the Landscape Architect or the Owner's authorized representative.

1.2 SUBMITTALS:

- A. Procedure: In accordance with Division One, or two weeks prior to start of installation.
- B. Submit one pint sample of the specified decomposed granite, with named source.

PART 2 - PRODUCTS

2.1 DECOMPOSED GRANITE:

- A. Decomposed granite is referred to by the abbreviation (D.G.), or referred to as disintegrated granite. All decomposed granite for vehicular surfaces shall conform to the following grading requirements:

Sieve Designation	% Passing
3/8 inch	100
No. 4	95-100
No. 8	75-80
No. 16	55-65

Sieve Designation	% Passing
No. 30	40-50
No. 50	25-35
No. 100	20-25
No. 200	5-15

- B. The portion of D.G retained on the no. 4 sieve shall have a maximum percentage of wear of 50 at 500 revolutions as determined by AASHTO T96.
- C. The portion passing a No. 40 sieve shall have a maximum liquid limit of 25 and maximum plasticity index of 7 as determined by AASHTO T89 and AASHTO T90, respectively.
- D. D.G. to be used for pathways and non-vehicular areas may be ¼" minus sieve size.
- E. Crushed aggregate screenings shall be free from clay lumps, vegetative matter and deleterious material.
- F. See Drawings for D.G. color specification.

2.2 SOIL STABILIZER:

- A. Stabilizer shall be a non-toxic, colorless, odorless, organic powder that binds D.G. screenings. The stabilizer shall be as manufactured by Stabilizer Inc., (800) 336-2468, FAX: (602) 852-0718.

2.3 EDGING

- A. Steel edging: 3/16" x 5 ½". Stakes 12" long, lock 1/2" below top of edging.
 1. Finish: Black anodized

PART 3 - EXECUTION

3.1 SUBGRADE AND DECOMPOSED GRANITE PREPARATION AND COMPACTION

- A. Subgrade and base under all D.G. shall be prepared and compacted to 90% relative compaction.
- B. Minimum compaction for D.G. surfaces shall be 90% relative compaction.
- C. The finish grade shall be even between the headers with no humps or depressions after the compaction. The Contractor shall provide compaction tests as required by the Architect.
- D. Treat compacted subgrade with pre-emergent herbicide, as recommended by certified pest control advisor.

3.2 SOIL STABILIZER AND DECOMPOSED GRANITE INSTALLATION

- A. Soil stabilizer shall be thoroughly blended with the D.G. screenings prior to installation.
 1. The stabilizer shall be mixed at a rate of 12 Lbs. of Stabilizer product per ton of D.G. screenings.
 2. Mixed stabilizer product in accordance with its manufacturer's instruction.
 3. Premixed Stabilizer and D.G. material can be obtained locally by contacting the stabilizer manufacturer and obtaining the location of a local vendor.

4. Not acceptable: drop spreading of the Stabilizer product over raked D.G. screenings and mixing stabilizer by rototilling.
- B. Place the premixed stabilizer product on the desired subgrade in maximum 2" lifts. Rake smooth to the desired grade and cross slope.
- C. After placement and raking, water the Stabilized D.G. to achieve full depth moisture penetration of the placed product. A one-hour rate of 20 gpm per 1,000 sq. ft. should achieve the proper full depth moisture penetration.
- D. While the Stabilized D.G. is still thoroughly moist roll the material with a heavy lawn roller, approximately 1000 to 3000 pounds, and maximum 30" wide, to achieve finish grade and initial compaction. Utilize a hand tamp at edges, around benches, and sign posts. Do not use a wacker or vibratory roller to compact the Stabilized D.G.
 1. Compacted finish surface of DG is to be level with adjacent paving, unless otherwise indicated.
 2. Compacted finish surface of DG is to be one-inch above finish grade in adjacent planting areas, unless otherwise indicated.
- E. Allow the finished surface sufficient time to dry prior to use.

3.3 CLEANUP

- A. After all stabilization operations are completed, remove trash, excess materials, empty containers and rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a smooth condition throughout the site.

END OF SECTION 32 15 30

SECTION 32 17 13

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 REFERENCE:

- A. Related Sections:
 - 1. Section 321216: Asphalt Paving.

1.02 DESCRIPTION:

- A. Principal Work Items Are:
 - 1. Painted lines, lettering, and symbols at parking areas.
 - 2. Painted stripes at exterior stairs.
 - 3. Fire Lane "No Parking."
 - 4. Curb marking and red curbs.

1.03 JOB CONDITIONS:

- A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.
- B. Sequencing, Scheduling: Coordinate with paving work. Verify that paint type is compatible with asphalt paving surfaces seal coats.
- C. Protection: Do not apply pavement markings for seven days after application of asphalt surface seal coat. After application, protect from traffic until thoroughly dry.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Traffic Paint:
 - 1. Type: Water base, roadway traffic lane marking type; colors as selected.
 - 2. Acceptable Manufacturers:

- a. Dunn-Edwards, Vin-L-Stripe No. W-801, vinyl-epoxy as a standard of quality.
- b. J. E. Bauer latex base Formula No. 1030A9 White, No. 1056A9 Yellow, No. 1865A9 Blue, No. 1118A9 Green, and No. 1854A9 Red.
- c. Sinclair No. 160 Vinyl Traffic Line Paint, water base.
- d. Ennis Traffic Safety Solutions, product 6000 white & 6006 blue.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Layout: Accurately measure and layout work. Use stencils for all work; snap lines for straight work.
- B. Prior to application of paint, allow the pavement to properly cure. Clean and prepare in accordance with paint manufacturer's written recommendations.
- C. Provide mechanical equipment to install paint in a uniform, straight or curved pattern, without holidays and other defects.
- D. Do not permit traffic until paint has completely cured.
- E. Provide two installations/applications of pavement marking; once for initial use and once after final seal coat.
- F. Install 2 coats in thickness recommended by manufacturer.

3.02 APPLICATION:

- A. Painted Lines, Lettering, and Symbols At Parking Areas:
 - 1. Parking Stall Lines: 4 inches wide, color white.
 - 2. Access aisles for accessible parking spaces shall be marked by a blue painted borderline around their perimeter. The area within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3.
 - 3. Access aisles for passenger drop-off and loading zone shall be marked with a painted borderline around the perimeter. The area within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. CBC section 11B-503.5.

4. Color: White, for all work except blue at wheelchair accessible parking stalls borders and red at Fire Lanes.
 5. Specific areas designated as fire lanes must be marked with red curbs using OSHA safety red paint. "FIRE LANE – NO PARKING" shall be painted on the top of curb in 3" white lettering at a spacing of 30' on center or portion thereof.
 6. Painted lines and markings on pavement at wheelchair accessible parking stalls shall be 4 inches wide (blue in color) equal of Color No. 15090 per Federal Standard 595C.
 7. Detectable warnings surfaces shall comply with CBC Section 11B-705.1.
 8. Detectable warning surfaces shall be yellow conforming to FS 33538 of Federal Standard 595B, except for locations at curb ramps, islands, or cut-through medians where color used shall contrast visually with that of adjacent walking surfaces, either light-on-dark, or dark-on-light. CBC Sections 11B-705.1.1.3 and 11B-705.1.1.5.
 9. Provide a minimum 5 year warranty on detectable warning surfaces per DSA Bulletin 10/31/02, revised 04/09/08.
- B. Stripes At Exterior Stairs:
1. Stripes: 2" wide, located 2" from, and parallel to, nosing.
 2. Required Locations: All treads, all top landings, all intermediate landings.

END OF SECTION

SECTION 32 32 13
CAST-IN-PLACE CONCRETE RETAINING WALLS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. Requirements of "General Conditions of the Contract" and of Division 1, "General Requirements," apply to work in this Section with same force and effect as though repeated in full herein.

1.02 SCOPE OF WORK

- A. Furnish materials, labor, transportation, services, and equipment necessary to furnish and install sedimentary wall system as indicated on Drawings and as specified herein.
- B. Work related in other Sections:
 - 1. Section 07 92 00 – Joint Sealants.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Federal, state and local laws and regulations governing this work are hereby incorporated into and made part of this section. When this section calls for certain materials, workmanship, or a level of construction that exceeds the level of Federal, State, or local requirements, provisions of this section take precedence.

1.04 APPLICABLE STANDARDS

- A. Specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code, referred to in this Specification with their individual designations are to be considered part of this Specification.
- B. Design and Control of Concrete Mixtures – Thirteenth Edition; Portland Cement Association.

1.05 QUALITY CONTROL

- A. Subcontractor Qualifications:
 - 1. Provide evidence to indicate successful experience in providing similar to that specified herein and demonstrate successful experience.
 - 2. Demonstration of experience: Provide a minimum of 1 local project within a 100 mile radius of project site of an installed sedimentary wall system with contact information for the Owner's Representative for each project.

1.06 SITE INSPECTION

- A. Verify conditions at site that affect work of this Section.
- B. Take field measurements as required.
- C. Report major discrepancies between drawings and field dimensions to Owner's Authorized Representative prior to commencing work.

1.07 SUBMITTALS

- A. Product Data: Submit no later than 10 days after contract award a typed list of products specified in this Section.
- B. Shop Drawings:
 - 1. Submit shop drawings for reinforcing steel and accessories in accordance with ACI standards.
 - 2. Paving Jointing and Pour Sequence Plan: Submit six blueprints indicating the following:
 - a. Proposed sedimentary layers and vertical dimensions of each layer.
 - b. List of each material to be used and clearly indicated on elevation shop drawing.
 - c. Concrete pour sequence: Indicated sequence of pour installation.
- C. Statement of Mix Design: Submit (1) copy of Statement of Mix Design prepared by batch plant servicing Project for each load delivered to Project. Statement of Mix Design to contain following information:
 - 1. Name, address, and telephone number of batch plant preparing statement of mix design.
 - 2. Date of mix design.
 - 3. Project location.
 - 4. Contractor requesting load delivery.
 - 5. Mix design number.
 - 6. Integral color used.
 - 7. Gradations for sand and aggregate.
 - 8. Material weights, specific gravity, and absolute volumes.
 - 9. Basis of testing, i.e. UBC 2605 D4 and Title 24 2604 D4.
 - 10. Water/cement ratio.
 - 11. PSI rating.
 - 12. Signature of testing laboratory manager.
 - 13. Signed stamp from registered project structural engineer or architect.
- D. Washed Concrete Sand (extra stock):
 - 1. One 50-pound sealed bag of washed concrete sand similar to type used during installation.

1.08 SUBSTITUTIONS

- A. None allowed unless approved in writing by Owner's Authorized Representative.

1.09 TESTING

- A. A testing agency may be designated by Owner or Owner's Authorized Representative. Testing personnel to meet ASTM E329 requirements.

1.10 MOCK-UPS

- A. Prior to construction, provide eight (8) 4-foot long x required height x 12-inch wide sample of sedimentary wall system specified on Drawings.

- B. Locate mock-ups in a conveniently accessible and protected place. Approved mock-ups will be standard for future installation review.
- C. Remove mock-ups from site upon completion of work and approval by Owner's Authorized Representative.

1.11 PROJECT CONDITIONS

- A. Keep work area clean, and in a safe and workman-like condition so that rubbish, waste and debris do not interfere with work of other trades.

1.12 PRODUCT HANDLING

- A. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.
- B. Keep aggregate dry at all times prior to installation.

1.13 COORDINATION

- A. Notify Owner's Authorized Representative and contractors performing work related to installation of Contractor's Work in ample time, so as to allow sufficient time for them to perform their portion of work.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT

- A. Type I, IA, II, IIA, III, IIIA, IV, and V cements, to conform to ASTM C150.
- B. Use same brand of cement from single source throughout entire project. Refer to Drawings for cement type specified.
- C. Sedimentary wall colors to be formulated by installer per wall systems.
- D. Special colors and textures are achieved per sedimentary wall systems with consent of the design intent of the project.

2.02 WASHED CONCRETE SAND

- A. Clean, hard, and durable washed concrete sand, conforming to ASTM C33.
- B. Use same sand from single source throughout entire project.

2.03 COARSE AGGREGATE

- A. Clean, hard, and durable coarse aggregate, conforming to ASTM C33.
- B. Use same aggregate from single source throughout entire project.

2.04 WATER

- A. Free from deleterious materials such as oils, acids, and organic matter.

2.05 ADMIXTURES

- A. Integral Concrete Coloring Admixture: Refer to project Shop Drawings for color type. All Lithocrete sedimentary wall system's incorporate project specific color systems and shall be

referenced in the project submittal package after contract and verified in the close out package to ownership.

- B. Air Entrainment Admixtures: Conforming to ASTM C260.
 - 1. Acceptable Manufacturers:
 - a. Grace Construction Products; Daravair®, (800) 433-0020 or www.graceconstruction.com/concrete/air_entraining.html#daravair.
 - b. Master Builders, Inc.; Micro-Air®, (800) 628-9990 or www.masterbuilders.com/MB/pub/Product.asp?TypeCat=2&ParentID=78&ProductID=22.
- C. Water Reducing Admixtures: Conforming to ASTM C494, Type A.
 - 1. Acceptable Manufacturers:
 - a. Grace Construction Products; WRDA® (800) 433-0020 www.graceconstruction.com/concrete/water_reducers.html#wrda.
 - b. Master Builders, Inc.; Micro-Air® (800) 628-9990 or www.masterbuilders.com.
- D. Shrinkage Reducing Admixtures: Conforming to ASTM C157.
 - 1. Acceptable Manufacturers:
 - a. Grace Construction Products; Eclipse® (800) 433-0020 or www.graceconstruction.com/concrete/shrinkage_reducers.html#eclipse.
 - b. Eclipse® Shrinkage Reducing Admixture is a liquid admixture which dramatically reduces concrete shrinkage and curling due to drying.

2.06 Surface retardant

- A. Eurotard by Grace form retarder
- B. Lithocrete® Etch Retarder®.
- C. Lithoseal™ sealer.

2.07 READY MIXED CONCRETE

- A. Batched mixed and transported in accordance with ASTM C94 - "Specifications for Ready Mixed Concrete."

2.08 REINFORCING

- A. Reinforcing Steel: Conforming to ASTM A615, clean and free of rust, dirt, grease or oils.
- B. Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.
- C. Supports for Reinforcement:
 - 1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars in place.
- D. Polypropylene Fiber Reinforcement: 100% virgin multifilament polypropylene fibers, complying with ASTM C 1116 - Type III.
 - 1. Acceptable Manufacturers:
 - 2. Fibermesh; Fibermix Stealth® – 1/4" long (423) 892-8080 or www.fibermesh.com/family/stealth.htm.

3. Grace Construction Products; MicroFiber™ (800) 433-0020 or www.graceconstruction.com/concrete/fibers.html
4. Application Rate: 1/2 lb. /cy of mix.

PART 3 - EXECUTION

3.01 FORMING: FORM MATERIALS FOR STRUCTURAL COMPONENTS

- A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork with plywood, panel type materials to provide continuous, straight, smooth, exposed surfaces.
- B.
 1. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Contract Drawings.
 2. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
 3. Provide forms that comply with US Product Standard PS 1 and the following:
 4. 3/4" Medium Density Overlaid exterior Class I mill oiled and edge sealed, with each piece bearing legible inspection trademark.
- C. Forms for Unexposed Finish Concrete: Provide forms of plywood. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.
- D. Forms for Textured Finish Concrete: Provide forms with face design, size, arrangement and configuration as shown on Contract Drawings, or as required to match control sample. Provide solid backing and form supports to ensure stability of textured form liners.
- E. Use 1.5 lb foam for course effect and shape with Sureform planes.
- F. Laminate all radius forms with 2 layers of 3/8" A.C.X and 1 finish layer of M.D.O. fully gun nailed at 6" o.c. to studs and wallers at 18" O.C.E.W.

3.02 DESIGN OF MIXES AND PROPORTIONING

- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength in accordance with current edition of ACI Manual of Concrete Practice and PCA "Design and Control of Concrete Mixtures."
- B. Concrete mixtures to be designed by an approved commercial testing laboratory, using approved materials to obtain specified minimum compressive strength, by owner.
- C. Concrete Mix Criteria:
 1. Slump: 5-inch, with a 1/2-inch slump differential between successive batches. Obtain approval from Owner's Authorized Representative if slump is outside these parameters.
 2. Minimum PSI Rating at 28 days: 2,500.
 3. Cement quantity per yard of mix:
 - a. Minimum: 6 sacks.
 - b. Maximum: 7 sacks.
 4. Water/cement ratio: 0.65 – 0.67.
 5. Sand: 70% of total mix.

6. Pea gravel: 30% of total mix.
7. Admixtures:
 - a. Air entrainment: Do not exceed 2%.
 - b. Shrinkage Reducing: Do not exceed 2% by weight of cement.
8. Fly ash: Use only when seeding reactive aggregates such as glass and seashells.
9. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
10. Concrete Delivery: Use of concrete loads exceeding 90 minutes from time of batch plant must be approved by Owner's Authorized Representative.
11. Ensure that batch plant guarantees single source supply for cement, sand, and aggregate for the entire project.

3.03 JOINTING

- A. Refer to ACI 302 "Guide for Concrete Floor and Slab Construction" for work under this section.
- B. Construction and Contraction Joints:
 1. Sawcut construction and contraction joints in locations indicated on Drawings.
 2. Perform jointing with a new diamond tip circular saw.
 3. Joint Width: Per Drawings. Do not exceed 3/16-inch in width.
 4. Depth of sawcuts: 1/4th depth of slab.
 5. Decorative Sawcut Joints: Per Drawings.
 6. Sawcut joints in a straight line with no overcutting.
 7. Use a hand tool to sawcut up to vertical edges such as walls, steps, curbs and columns. No cutting into vertical surfaces will be allowed.

3.04 CURING

- A. After initial concrete installation, sprinkle or fog with water for minimum 7 days.

3.05 SEALING

- A. Seal surface of wall surface.
- B. Follow Sealer directions when applying this product (sealer must be applied in 3 to 6 coats).

END OF SECTION 32 32 13

SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. It is the intent of the specifications and drawings that the finished system is complete in every respect and shall be ready for operation satisfactory to the District.
- B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated on the drawings, in these specifications, and as necessary to complete the contract.

1.2 CONSTRUCTION DRAWINGS

- A. All offsets, fittings, sleeves, etc. which may be required are not shown on the drawings. The Contractor shall carefully investigate the structural and finished conditions affecting the work and plan the work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
- B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Landscape Architect shall have final authority for clarification.
- C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect as soon as detected. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revision necessary.

1.3 QUALITY ASSURANCE

- A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.
- B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the drawings and specifications.
- C. All local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their

provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.

- D. All materials supplied for this project shall be new and free from any defects. All defective materials shall be replaced immediately at no additional cost to District.
- E. Secure the required licenses and permits including payments of charges and fees, give required notices to public authorities and verify permits secured or arrangements made by others affecting the work of this section.

1.4 SUBMITTALS

A. Water Pressure Test

- 1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the District a written verification of the existing water pressure on the project at each of the points of connection shown.
- 2. The water pressure test shall be performed to measure the dynamic water pressure at the point of connection at the maximum flow rate of the proposed irrigation system as shown on the point of connection note. Dynamic water pressure is when water is flowing through the point of connection. Static water pressure readings when water is not flowing, are not acceptable.
- 3. Written dynamic water pressure test confirmation shall be made on the contractor's letterhead and include the flow rate during the test, the recorded water pressure, the date of the test and the time of the test.

B. Material List:

- 1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the District a complete list of all irrigation system materials, or processes proposed to be furnished and installed as part of this contract.
- 2. The submittal materials list shall include the following information:
 - a. A title sheet with the job name, the contractor's name, contractor's address and telephone number, submittal date and submittal number.
 - b. An index sheet showing the item number (e.g. 1,2,3, etc.); an item description (e.g. sprinkler head); the manufacturer's name (e.g. Hunter Industries); the item model number (e.g. I-40-ADV/36V); and the page(s) in the submittal set that contain the catalog cuts.
 - c. The catalog cuts shall be one or two pages copied from the most recent manufacturer's catalog that indicate the product submitted. Do not submit parts lists, exploded diagrams, price lists or other extra information.
 - d. The catalog cuts shall clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes shall be circled on the catalog cuts.

- e. Submittals for equipment indicated on the legend without manufacturer names, or “as approved”, shall contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.
- 3. Submittal materials list format requirements:
 - a. Submittals shall be provided as one complete package for the project in electronic pdf format. Multiple partial submittals will not be reviewed.
 - b. Submittal package shall have all pages numbered in the lower right hand corner. Page numbers shall correspond with submittal index.
 - c. Re-submitted packages must be revised to include only the equipment being re-submitted. Equipment previously reviewed and accepted shall not be re-submitted in the materials list/index sheet or in the catalog cut sheet package.
- C. Substitutions: If the Irrigation Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation drawings and specifications, he may do so by providing the following information to the Landscape Architect or District's authorized representative for approval.
 - 1. Provide a written statement indicating the reason for making the substitution.
 - 2. Provide catalog cut sheets, technical data, and performance information for each substitute item.
 - 3. Provide in writing the difference in installed price if the item is accepted.
- D. The Landscape Architect or District’s authorized representative will allow no substitutions without prior written acceptance
- E. No substitutions of pump manufacturers, distributors or assemblies will be accepted.
- F. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.
- G. The Landscape Architect or District’s authorized representative will not review the submittal package unless provided in the format described above.

1.5 EXISTING CONDITIONS

- A. Verify and be familiar with the locations, size and detail of points of connection provided as the source of water, electrical supply, and ethernet connection to the irrigation system.
- B. Irrigation design is based on the available static water pressure shown on the drawings. Contractor shall verify static water on the project prior to the start of construction. Should a discrepancy exist, notify the Landscape Architect and District's authorized representative prior to beginning construction.
- C. Prior to cutting into the soil, locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground, and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the Contractor shall promptly notify the Landscape Architect and District who will arrange for relocations. The Contractor will proceed in the same manner if a rock layer or any other such conditions are encountered.

- D. Protect all existing utilities and features to remain on and adjacent to the project site during construction. Repair, at its own cost, all damage resulting from his operations or negligence.
- E. The Irrigation Contractor shall coordinate with the General Contractor for installation of required sleeving as shown on the plans prior to paving operations.
- F. Verify and be familiar with the existing irrigation systems in areas adjacent to and within the Project area of work.
- G. Protect all existing irrigation systems, in areas adjacent to and within the project area of work, from damage due to his operations.
- H. Notify District's Representative if any existing system is temporarily shut off, capped or modified. Provide 48-hour notice, prior to turning off or modifying any existing irrigation system.
- I. Repair or replace all existing irrigation systems, in areas adjacent to and within the project area of work, damaged by the construction of this project. Adjacent irrigation systems shall be made completely operational and provide complete coverage of the existing landscaped areas. All repairs shall be complete to the satisfaction of the District's Representative.
- J. Provide bore holes under any existing pavement or paving encountered for the required lateral, mainline and low voltage control wire sleeving. Bore holes under 2 inches in diameter and smaller shall be made with a BulletMole® underground boring tool as manufactured by Dimension Tools, LLC (Contact telephone number (888)-650-5554 or at www.bulletmole.com). Bore holes larger than 2 inches in diameter shall be made with an approved mechanical boring tool. No air jacking or hydraulic boring of any kind shall be allowed.

1.6 INSPECTIONS

- A. The Contractor shall permit the Landscape Architect and District's authorized representative to visit and inspect at all times any part of the work and shall provide safe access for such visits.
- B. Where the specifications require work to be tested by the Contractor, it shall not be covered over until accepted by the Landscape Architect, District's authorized representative, and/or governing agencies. The Contractor shall be solely responsible for notifying the Landscape Architect, District, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it shall be, if so ordered, uncovered at the Contractor's expense.
- C. Inspections will be required for the following at a minimum:
 1. Pre-construction meeting.
 2. System layout.
 3. Pressure test of irrigation mainline (Four hours at 125 PSI or 120% of static water pressure, whichever is greater.) Mainline pressure loss during test shall not exceed 2 PSI.

4. Coverage test of irrigation system. Test shall be performed prior to any planting.
 5. Final inspection prior to start of maintenance period.
 6. Final acceptance prior to turnover.
- D. Site observations and testing will not commence without the field record drawings as prepared by the Irrigation Contractor. Record drawings must be complete and up to date for each site visit.
- E. Work that fails testing and is not accepted will be retested. Hourly rates and expenses of the Landscape Architect, District's authorized representative, and governing agencies for re-inspection or retesting will be paid by the Irrigation Contractor at no additional expense to District.

1.7 STORAGE AND HANDLING

- A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Landscape Architect and District and at no additional cost to the District.
- B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

1.8 CLEANUP AND DISPOSAL

- A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris will not be permitted. Remove and dispose of rubbish and debris at frequent intervals or when ordered to do so by the District's authorized representative.
- B. At the time of completion the entire site will be cleared of tools, equipment, rubbish and debris which shall be disposed of off-site in a legal disposal area.

1.9 TURNOVER ITEMS

- A. Record Drawings:
1. Record accurately on one set of drawings all changes in the work constituting departures from the original contract drawings and the actual final installed locations of all required components as shown below.
 2. The record drawings shall be prepared to the satisfaction of the District. Prior to final inspection of work, submit record drawings to the Landscape Architect or District's authorized representative.
 3. All record drawings shall be prepared using AutoCAD 2019 drafting software and the original irrigation drawings as a base. No manual drafted record drawings shall be acceptable. The Contractor may obtain digital base files from the Landscape Architect or District's authorized representative.

4. If the Contractor is unable to provide the AutoCAD drafting necessary for the record drawings the irrigation designer does provide record drawing drafting as a separate service.
 5. Prior to final inspection of work, submit record drawings plotted onto vellum sheets for review by the Landscape Architect or District's authorized representative. After acceptance by the Landscape Architect, City Inspector or District's authorized representative re-plot the record drawings onto reproducible Mylar sheets. The Contractor shall also provide record drawing information on a digital AutoCAD Release 2019 drawing file. All digital files shall be provided on a compact disc (CD) clearly marked with the project name, file descriptions and date.
 - a. Record drawing information and dimensions shall be collected on a day-to-day basis during the installation of the pressure mainline to fully indicate all routing locations and pipe depths. Locations for all other irrigation equipment shall be collected prior to the final inspection of the work.
 - b. Two dimensions from two permanent points of reference such as buildings, sidewalks, curbs, streetlights, hydrants, etc. shall be shown for each piece of irrigation equipment shown below. Where multiple components are installed with no reasonable reference point between the components, dimensioning may be made to the irrigation equipment. All irrigation symbols shall be clearly shown matching the irrigation legend for the drawings. All lettering on the record drawings shall be minimum 1/8 inch in size.
 6. Show locations and depths of the following items:
 - a. Point of connection (including water POC, backflow devices, master control valves, flow sensors, etc.)
 - b. Routing of sprinkler pressure main lines (dimensions shown at a maximum of 100 feet along routing)
 - c. Isolation valves
 - d. Automatic remote control valves (indicate station number and size)
 - e. Quick coupling valves
 - f. Drip air relief and flush valves
 - g. Routing of control wires where separate from irrigation mainline
 - h. Related equipment (as may be directed)
- B. Controller Charts:
1. Provide one controller chart for each automatic controller. Chart shall show the area covered by the particular controller. The areas covered by the individual control valves shall be indicated using colored highlighter pens. A minimum of six individual colors shall be used for the controller chart unless less than six control valves are indicated.
 2. Landscape Architect or District's authorized representative must approve record drawings before controller charts are prepared.
 3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a readable size.
 4. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.

C. Operation and Maintenance Manuals:

1. Two individually bound copies of operation and maintenance manuals shall be delivered to the Landscape Architect or District's authorized representative at least 10 calendar days prior to final inspection. The manuals shall describe the material installed and the proper operation of the system.
 2. Each complete, bound manual shall include the following information:
 3. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment including names and addresses of local manufacturer representatives.
 - a. Operating and maintenance instructions for all equipment.
 - b. Spare parts lists and related manufacturer information for all equipment.
- D. Equipment:
1. Supply as a part of this contract the following items:
 - a. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head used in the irrigation system.
 - b. Three 30-inch sprinkler keys for manual operation of control valves.
 - c. Two quick coupler keys with a 1" bronze hose bib, bent nose type with hand wheel and two coupler lid keys.
 - d. One valve box cover key or wrench.
 - e. Six extra sprinkler heads of each size and type.
 - f. For specified ball valves if required: One (1) 5-foot long valve handle, to fit the specified ball valves.
 2. The above equipment shall be turned over to District's authorized representative at the final inspection.

1.10 COMPLETION

- A. At the time of the pre-maintenance period inspection, the Landscape Architect, District's authorized representative, and governing agencies will inspect the work, and if not accepted, will prepare a list of items to be completed by the Contractor. Punch list to be checked off by contractor and submitted to Landscape Architect or District's authorized representative prior to any follow-up meeting. This checked off list to indicate that all punch list items have been completed. At the time of the post-maintenance period or final inspection the work will be re-inspected and final acceptance will be in writing by the Landscape Architect, District's authorized representative, and governing agencies.
- B. The District's authorized representative shall have final authority on all portions of the work.
- C. After the system has been completed, the Contractor shall instruct District's authorized representative in the operation and maintenance of the irrigation system and shall furnish a complete set of operating and maintenance instructions.
- D. Any settling of trenches which may occur during the one-year period following acceptance shall be repaired to the District's satisfaction by the Contractor without any additional expense to the District. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

1.11 GUARANTEE

- A. The entire sprinkler system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.
- B. Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to District within ten (10) calendar days of receipt of written notice from District. When the nature of the repairs as determined by the District constitute an emergency (i.e. broken pressure line) the District may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the District by the Contractor, all at no additional cost to the District.
- C. Guarantee shall be submitted on Contractors own letterhead as follows:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defective material during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the District. We shall make such repairs or replacements within 10 calendar days following written notification by the District. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from District, we authorize the District to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT NAME:

PROJECT LOCATION:

CONTRACTOR NAME:

ADDRESS:

TELEPHONE:

SIGNED:

DATE:

PART 2 - MATERIALS

2.1 SUMMARY

Use only new materials of the manufacturer, size and type shown on the drawings and specifications. Materials or equipment installed or furnished that do not meet Landscape Architect's, District's, or governing agencies standards will be rejected and shall be removed from the site at no expense to the District.

2.2 PIPE

- A. Pressure supply line between the water meter and the backflow prevention device shall be type K copper, one size larger than backflow device.
- B. Backflow prevention assemblies, and all other above grade assemblies, shall be constructed of threaded brass pipe and threaded brass fittings the same size as the backflow device, unless otherwise directed.
- C. Pressure supply lines 2 inches in diameter and up to 3 inches in diameter downstream of backflow prevention unit shall be Class 315 solvent weld PVC. Piping shall conform to ASTM D2241.
- D. Non-pressure lines 3/4 inch in diameter and larger downstream of the remote control valve shall be SCH 40 solvent weld PVC conforming to ASTM D1785.

2.3 METAL PIPE AND FITTINGS

- A. Brass pipe shall be 85 percent red brass, ANSI, IPS Standard 125 pounds, Schedule 40 screwed pipe.
- B. Fittings shall be medium brass, screwed 125-pound class.
- C. Copper pipe and fittings shall be Type "K" sweat soldered or brazed as indicated on the drawings.

2.4 PLASTIC PIPE AND FITTINGS

- A. Pipe shall be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.
- B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2672, ASTM D2241 or ASTM D1785.
- C. All solvent weld PVC fittings shall be standard weight Schedule 40 (and Schedule 80 where specified on the irrigation detail sheet, all mainline fittings shall be Schedule 80 PVC) and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2464 and ASTM D2466.

- D. All threaded nipples shall be standard weight Schedule 80 with molded threads and shall conform to ASTM D1785.
- E. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.
- F. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.
- G. All pressure mainlines installed with solvent weld PVC fittings shall be installed with concrete thrust blocking at all directional changes in the mainline routing. Concrete thrust blocking shall not be required when ductile iron fittings and mechanical restraints are specified.

2.5 VALVES

- A. Ball Valves:
 - 1. Ball valves shall be of the manufacturer, size, and type indicated on the drawings.
 - 2. All ball valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA standards.
- B. Quick Coupler Valves:
 - 1. Quick coupler valves shall be of the manufacturer, size, and type indicated on the drawings.
 - 2. Quick coupler valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have 1" female threads opening at base, with two-piece body. Valves to be operated only with a coupler key, designed for that purpose. Coupler key is inserted into valve and a positive, watertight connection shall be made between the coupler key and valve.
- C. Automatic Control Valves:
 - 1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
 - 2. Automatic control valves shall be electrically operated.
 - 3. Provide Christy's valve ID tags for each remote control valve with valve number.

2.6 VALVE BOXES

- A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.
- B. The valve box cover shall be green in color and secured with a hidden latch mechanism or bolts.
- C. Valve box extensions shall be by the same manufacturer as the valve box.
- D. The plastic irrigation valve box cover shall be an overlapping type.

- E. Automatic control valve boxes shall be 17"x11"x12" nominal rectangular size. Valve boxes for drip valve assemblies shall be Jumbo valve boxes size as required to fit assemblies. Valve box covers shall be marked "RCV" with the valve identification number, or "MV", "FS" "heat branded" onto the cover in 1-1/4 inch high letters / numbers.
- F. Quick coupler and ball valve boxes shall be 10" circular size. Valve box covers shall be marked with "QCV" or "BV" "heat branded" onto the cover in 1-1/4 inch high letters.

2.7 ELECTRICAL

- A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installations.
- B. All electrical work shall conform to local codes and ordinances.

2.8 LOW VOLTAGE CONTROL WIRING

- A. Remote control wire shall be direct-burial AWG-UF type, size as indicated on the drawings, and in no case smaller than 14 gauge.
- B. Connections shall of the manufacturer, size, and type indicated on the drawings.
- C. Common wires shall be white in color. Control wires shall be red (where two or more controllers are used, the control wires shall be a different color for each controller. These colors shall be noted on the "Record Drawings" plans located on controller door).
- D. Ground wires shall be green in color or bare copper and in no case smaller than 6 gauge.

2.9 IRRIGATION HEADS, DRIP EMITTERS, AND INLINE DRIP TUBING

- A. Irrigation heads, drip emitters, and inline drip tubing shall be of the manufacturer, size, type, with radius of throw, operating pressure, and discharge rate indicated on the drawings.
- B. Irrigation heads, drip emitters, and inline drip tubing shall be used as indicated on the drawings.

2.10 DRIP IRRIGATION EQUIPMENT

Drip tubing equipment such as flush valves, air relief valves, wye strainers and pressure regulators shall be of the manufacturer, size, and type indicated on the drawings.

2.11 MISCELLANEOUS EQUIPMENT

- A. Landscape Fabric:
 - 1. Landscape fabric for valve box assemblies shall be 5.0- oz. weight woven polypropylene weed barrier. Landscape fabric shall have a burst strength of 225 PSI, a puncture strength of 60 lbs. and capable of water flow of 12 gallons per minute per square foot.
 - 2. Type: DeWitt Pro 5 Weed Barrier or approved equal.

- B. Equipment such as flush valves shall be of the manufacturer, size and type indicated on the drawings.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

- A. Inspections:
 - 1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 - 2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the Landscape Architect or District's authorized representative.
 - 2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.
- C. Grades:
 - 1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.
 - 2. Final grades shall be accepted by the Engineer before work on this section will be allowed to begin.
- D. Field Measurements:
 - 1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other work.
 - 2. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this section.
 - 3. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities, which are caused by his operations or neglect.
- E. Diagrammatic Intent:

The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform with structures and to avoid obstructions or conflicts with other work at no additional expense to District.
- F. Layout:
 - 1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads, valves, backflow preventer, and automatic controller.
 - 2. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.

- G. Water Supply:
Connections to, or the installation of, the water supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to District.
- H. Electrical Service:
 - 1. Connections to the electrical supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to District.
 - 2. Contractor shall make electrical connections to the irrigation controller. Electrical power source to controller locations shall be provided by others.
 - 3. Contractor shall make electrical connections to the irrigation controller. 230-volt single-phase electrical power source to pump assembly location shall be provided by others per NEC codes.

3.2 TRENCHING

- A. Excavations shall be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.
- B. Provide minimum cover of 18 inches on pressure supply lines 2 ½ inches and smaller.
- C. Provide minimum cover of 18 inches for control wires within planters.
- D. Provide minimum cover of 24 inches for control wires within sleeves below paving.
- E. Provide minimum cover of 36 inches on pressure supply lines under vehicular travel ways.
- F. Provide minimum cover of 12 inches for non-pressure lines.
- G. Pipes installed in a common trench shall have a 4-inch minimum space between pipes.

3.3 THRUST BLOCKS

- A. Thrust blocks must be constructed of Class "B" concrete.
- B. Thrust blocks shall be poured against undisturbed site soil.
- C. PVC fitting joints shall be kept free of concrete. Do not encase fitting in concrete.
- D. Thrust blocking shall be sized to provide the minimum bearing areas as shown below. Bearing areas indicated have been calculated for Class 200 PVC pipe at a test pressure of 150 PSI in soil with 2,000 PSI bearing capacity. Increase thrust block sizing as necessary for varying soil conditions.
 - 1. Provide a minimum thrust block bearing area of 2.0 square feet on all bends (all degrees) and tees installed on pressure supply lines 4 inches and smaller.

3.4 BACKFILLING

- A. Backfill material on all lines shall be the same as adjacent soil free of debris, litter, and rocks over 1/2 inches in diameter.
- B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.
- C. Flooding in lieu of tamping is not allowed.
- D. Under no circumstances shall truck wheels be used to compact backfill.
- E. Provide sand backfill a minimum of 4 inches over and under all piping under paved areas.

3.5 PIPING

- A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.
- B. Cutting or breaking of existing pavement is not permitted.
- C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs, and reaming. Install pipe with all markings up for visual inspection and verification.
- D. Remove all dented and damaged pipe sections.
- E. All lines shall have a minimum clearance of 4 inches from each other and 12 inches from lines of other trades.
- F. Parallel lines shall not be installed directly over each other.
- G. In solvent welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods including wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.
- H. PVC pipe shall be installed in a manner, which will provide for expansion and contraction as recommended by the pipe manufacturer.
- I. Center load all plastic pipe prior to pressure testing.
- J. All threaded plastic-to-plastic connections shall be assembled using Teflon tape or Teflon paste.

- K. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope on all threaded plastic-to-metal connections, except where noted otherwise. All plastic-to-metal connections shall be made with plastic male adapters.

3.6 CONTROLLER

- A. The Irrigation Contractor shall be responsible for the final electrical hook up to the irrigation controller.
- B. The irrigation system shall be programmed to operate during the periods of minimal use of the design area.

3.7 CONTROL WIRING

- A. Low voltage control wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.
- B. Where more than one wire is placed in a trench, the wiring shall be taped together in a bundle at intervals of 10 feet. Bundle shall be secured to the mainline with tape at intervals of 20 feet.
- C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.
- D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional change, and one of 24 inches shall be provided at each remote control valve.
- E. A continuous run of wire shall be used between a controller and each remote control valve. Under no circumstances shall splices be used without prior approval.

3.8 VALVES

- A. Automatic control valves, quick coupler, and ball valves are to be installed in the approximate locations indicated on the drawings.
- B. Valve shall be installed in shrub areas whenever possible.
- C. Install all valves as indicated in the detail drawings.
- D. Valves to be installed in valve boxes shall be installed one valve per box.
- E. Provide valve ID tags for each remote control valve with valve number.

3.9 VALVE BOXES

- A. Valve boxes shall be installed in shrub areas whenever possible.

- B. Each valve box shall be installed on a foundation of 3/4 inch gravel backfill, 3 cubic feet minimum. Valve boxes shall be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

3.10 IRRIGATION HEADS, DRIP EMITTERS, AND INLINE DRIP TUBING

- A. Irrigation heads, drip emitters, and inline drip tubing shall be installed as indicated on the drawings.
- B. Spacing of heads and inline drip tubing shall not exceed maximum indicated on the drawings.
- C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.

3.11 BACKFLOW PREVENTION UNITS

- A. The Contractor shall be responsible for the testing and certification of the backflow device for proper operation. Testing and certification shall be performed by a state qualified backflow tester.

3.12 MISCELLANEOUS EQUIPMENT

- A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.
- B. Quick coupler valves shall be set approximately 18 inches from walks, curbs, header boards, or paved areas where applicable.
- C. Install devices such as flush valves as indicated on the drawings and as recommended by the manufacturer.

3.13 FLUSHING THE SYSTEM

- A. Prior to installation of irrigation heads, the valves shall be opened and a full head of water used to flush out the lines and risers.
- B. Irrigation heads shall be installed after flushing the system has been completed.

3.14 ADJUSTING THE SYSTEM

- A. Adjust valves, align heads, and check the coverage of each system prior to coverage test.
- B. If it is determined by the Landscape Architect or District's authorized representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to any planting.
- C. The entire system shall be operating properly before any planting operations commence.
- D. Automatic control valves are to be adjusted so that the irrigation heads, drip emitters, and inline drip tubing operate at the pressure recommended by the manufacturer.

3.15 TESTING AND OBSERVATION

- A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the Landscape Architect, District, and governing agencies.
- B. The Contractor shall be solely responsible for notifying the Landscape Architect, District, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing.
- C. When the sprinkler system is completed, perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the Landscape Architect.
- D. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate, without bringing this to the attention of the Landscape Architect. This test shall be accepted by the Landscape Architect and accomplished before starting any planting.
- E. Areas to be maintained for the formal maintenance period shall start maintenance at the same time, as directed by the Landscape Architect, District, and governing agencies. Partial areas will not be released into maintenance prior to completion of items listed in the pre-maintenance review. The maintenance period may not be phased.
- F. If, after the maintenance review, the irrigation systems are not accepted by the Landscape Architect, the Contractor shall reimburse the Architect for additional site visits, or additional time required to review work. All additional time will be billed at the Architect's hourly rate and will be paid for by the Contractor at no additional cost to the District.
- G. Final inspection will not commence without record drawings as prepared by the Irrigation Contractor.

3.16 MAINTENANCE

During the maintenance period the Contractor shall adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage to all intended plantings.

3.17 COMPLETION CLEANING

Clean up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be swept, and any damage sustained on the work of others shall be repaired to original conditions.

END OF SECTION 32 84 00

SECTION 32 90 00

LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes materials, soil and installation in over-structure planters, soil preparation, planting, palm planting, seeding, sodding, staking and guying, and cleanup.
 - 1. Planting occurs at street level and on upper building levels.
- B. Related work:
 - 1. Section 32 01 91 - Operation and Maintenance of Planting
 - 2. Section 32 84 00: Irrigation System
- C. Definitions:
 - 1. Architect: the Architect or the Owner's authorized representative.
 - 2. Soil Test: Required testing performed by Contractor after site is rough graded. A current soil report is also required for import soil prior to transport to the site.
 - 3. Punch List: List of work within the Contract, generated by Architect that needs to be completed, repaired, replaced, or rectified by Contractor.
 - 4. Pre-maintenance review: Observation by Architect to verify substantial completion of the Work. The Architect will generate a Punch List during this review. Maintenance Period will commence when Contractor has completed items on this Punch List and Architect has verified that the Punch List is complete.
 - 5. Maintenance Period: See Specification section 32 01 91 - Operation and Maintenance of Planting.
 - 6. Final Acceptance: Observation review by Architect at end of the specified Maintenance Period to verify completion and acceptance of the Work.

1.2 QUALITY ASSURANCE

- A. Standards:
 - 1. Provide plants and planting materials that meet or exceed specifications of Federal, State, and County laws requiring inspection for plant disease or insect control.
 - 2. Provide quality and size conforming to current edition of "Horticultural Standards" for number one nursery stock as adopted by the American Association of Nurserymen.
 - 3. Provide plants that are true to name. Tag one of each bundle or lot with the name and size of plants in accordance with the standards of practice of the American Association of Nurserymen.
 - 4. Botanical names shall take precedence over common names.
- B. Workmanship: Perform work in accordance with the best standards of practice for landscape work and under the continual supervision of a competent foreman capable of interpreting the Drawings and Specifications.

- C. Quantities and Types: Plant materials shall be furnished in the quantities and/or spacings as shown or noted for each location, and shall be of the species, kinds, sizes, etc., as symbolized and/or described in the Plant List, and as indicated on the Drawings.
- D. Verification of dimensions and quantities: scaled dimensions are approximate. Before proceeding with work, carefully check and verify dimensions and quantities and immediately inform the Architect of discrepancies between the Drawings and/or specifications and actual conditions. Do not start work in areas where there are discrepancies until approval for same has been given by the Architect.

1.3 SUBMITTALS

- A. Submit documentation to Architect 60 days before start of planting that plant material is available. Include:
 - 1. A list of plants stating quantity, size, and supplier.
 - a. Requests for substitutions due to unavailability must be made in writing.
 - b. Substitutions may not be made without approval of the Architect.
 - c. Contractor shall notify Architect 24 hours in advance of delivery of plant materials, and shall submit an itemized list of plants in each delivery.
 - 2. Photographs of trees 24" box and larger.
 - a. Label each photo with plant name, plant height, spread and trunk caliper.
 - b. Label each photo with nursery name, nursery contact and phone number.
 - c. Photograph shall include a person in picture for scale purposes.
- B. Soil Test: Contractor shall have import soil and the soil of the site tested for fertility, agricultural suitability, and appraisal by Soil and Plant Laboratory Inc. (714) 282-8777, or Wallace Labs (310) 615-0116.
 - 1. Submit a copy of the Planting Plan and Plant Legend to the laboratory with the samples.
 - 2. Soil report shall include:
 - a. pH measurement.
 - b. Nutrients and elements:
 - 1) Measurement (low, medium, high) of: Boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorus, potassium, sodium, sulfur, and zinc.
 - 2) Analyze saturation extract for: calcium, magnesium, sodium, boron, chloride, phosphorus, nitrate and sulfate.
 - 3) Trace metals: Aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin and vanadium.
 - 4) The presence of calcium carbonate and/or magnesium carbonate.
 - c. Soil Texture (gravel, sand, silt and clay). Determine organic matter content by the measurement of organic carbon. The quality of the organic matter shall be determined by measuring organic carbon and total nitrogen.
 - 1) Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods, Soil Science Society of America, Inc., 1986, chapter 36, pgs 901-926 and Methods of Soil Analysis, Part 3 Chemical Methods, Soil Science Society of America, Inc, 1996, chapter 34, pgs 965-977 & pgs 1001-2 and chapter 37, pg 1088

- d. Interpretation and recommendations for correction of nutritional deficiencies/excesses and potential toxicities.
 - 3. Soil shall be tested from a minimum of four (4) locations per acre of planted area. Contractor shall record locations where samples were taken.
 - 4. A copy of the soil test results shall be submitted to the Owner and Architect before work begins.
 - 5. Contractor shall pay cost of soil tests.
- C. Cut sheets of materials to be used: tree stakes, tree guys, root barriers, amendments, mycorrhizal fungi, etc.
 - D. Legible copies of delivery slips for soil amendments, including mycorrhizal fungi.
 - E. The Contractor shall submit samples or specifications of items being used upon the request of the Architect, and as required by this Part 2 of this Specification.

1.4 OBSERVATION SCHEDULE

- A. Contractor shall be responsible for notifying the Architect, in advance, for the following observations, according to the time indicated:
 - 1. Pre-construction conference – seven (7) days
 - 2. Tree tagging at nursery (trees 24" box size and larger) – 48 hours
 - 3. Final grade, soil preparation and planting area layout review - 72 hours
 - 4. Plant materials review - 48 hours
 - 5. Plant layout review - 48 hours
 - 6. Planting operations - 48 hours
 - 7. Completed planting (Pre-maintenance) walk through – seven (7) days
- B. Contractor shall be responsible for scheduling site Observation visits with Architect as work progresses. Failure to schedule required Observations shall not relieve Contractor of responsibility for obtaining approvals. Contractor shall redo, at no cost to the Owner, work that does not satisfy the Owner.
- C. Observations may be waived or combined at the discretion of the Architect.
- D. When someone other than the Architect conducts Observations, the Contractor shall show evidence in writing of when and by whom these observations were made.
- E. No site visits shall commence without adequate preparation or items noted in previous Observation Reports, either completed or remedied, unless the Owner has waived such compliance. Failure to adequately prepare or accomplish previous punch list items shall make the Contractor responsible for reimbursing the Architect for the site visit at his current billing rates per hour plus transportation costs. No further inspections will be scheduled until this charge has been paid and received.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer or soil amendments to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trademark, and conformance to state

law. Protect material from damage or breakage. Immediately remove empty containers from site.

- B. Deliver plants with legible identification labels. Store plant material in shade and protect from weather or injury. Maintain in a healthy, vigorous condition. Architect may at time reject plant material not maintained in this condition.
- C. Handling: Do not drop plants or pick up container plants by their stems or trunks.

1.6 SAMPLES AND TESTS:

- A. Contractor shall submit soil samples for testing, per this Specification.
- B. Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request by Architect.
- C. Rejected materials shall be immediately removed from the site at the Contractor's expense.
- D. Contractor shall pay cost of testing or replacement of materials not meeting specifications.

1.7 WARRANTY AND REPLACEMENT

- A. Contractor shall fully warrant and agree to replace poor, inadequate, or defective materials and workmanship for one year from date of acceptance of completed planting work.
- B. Palm trees: Guarantee newly planted palm trees for a period of two years following planting and acceptance by Owner.
- C. Replacement: Materials found to be dead, missing, or in poor condition during the establishment period shall be replaced immediately. The Architect shall be the sole judge as to the condition of material. Material to be replaced during the warranty period shall be replaced by the Contractor within fifteen days of written notification by Owner.

PART 2 - PRODUCTS

2.1 SOIL

- A. Site Soil:
 - 1. Site soil used to form landscape planting areas or backfill planters shall be clean, fertile, loamy soil, free of stones, sticks, stumps, or other deleterious matter one inch in diameter or larger. It shall also be free from wire, plaster, construction debris, or similar objects that would be a hindrance to planting or maintenance.
 - 2. The Architect shall approve suitability of soil of the site after reviewing results of the soil test.
- B. Import Top Soil: Clean, fertile, sandy loam soil, free of stones or other deleterious matter one inch in diameter or larger. It shall also be free of pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes or other

undesirable disease-causing organisms such as insects and plant pathogens. Import top soil must conform to the following:

1. Particle size
 - a. Class Particle Size Range Maximum % Minimum %
 - b. Coarse sand 0.5 - 2.0mm 15 0
 - c. Silt plus clay <0.05mm 50 15
 - d. Other classes:
 - e. Gravel 2-13mm 15 0
 - f. Rock 1/2 - 1" 5% by volume with none > 1"
2. Chemistry
 - a. Salinity: Saturation Extract Conductivity (ECe) - less than 3.0 sD/m @ 25° C
 - b. Sodium: Sodium Absorption Ratio (SAR) - less than 6.0
 - c. Boron: Saturation Extract Concentration - Less than 1.0 ppm
 - d. Reaction: pH of Saturated Paste - 5.5-7.8 without high lime content
3. Soil shall contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium and magnesium to support normal plant growth. In the event of nutrient inadequacies, provisions shall be made to add required material prior to planting.
4. In order to insure conformance, samples of the import soil shall be submitted to an approved laboratory for analysis prior to and following backfilling.
5. Obtain imported topsoil from approved local sources.

C. Units are mg/kg dry weight determined with Ammonium bicarbonate DTPA extraction

D. Backfill for at grade trees and shrubs shall be per Soils Report.

E. Special mixes: see Drawings.

2.2 SOIL AMENDMENTS

A. Soil amendments shall be as required by Soils Test.

B. Contractor shall provide amendments recommended by Soils Report at no additional cost to Owner, including recommendations for the quality of organic amendment.

C. Mycorrhizal fungi shall be added in all planting areas, regardless of Soils Report. Mycorrhizal inoculum consists of a combination of :

1. Inoculum shall contain a blend of eight top types of Endospores: *Glomus aggregatum*, *G. clarum*, *G. deserticola*, *G. intraradices*, *G. monosporus*, *G. mosseae*, *Gigaspora margarita*, and *Paraglomus brasilianum*, and seven top types of Ecto fungi spores: *Laccaria laccata*, *Pisolithus tinctorius*, *Rhizopogon amylopogon*, *R. fulvigleba*, *R. rubescens*, *R. villosuli*, and *Scleroderma* spp. The guaranteed Endo spore count shall be a minimum 50 spores/cc, and the Ecto spore count shall be a minimum 50,000 spores/cc
2. Manufacturers:
 - a. BioOrganics Mycorrhizae Inoculants, (888) 332-7676
 - b. Mycorrhizal Applications, Inc, (866) 476-7800
 - c. Or equal.

2.3 PLANT TABLETS

- A. 7 gram planting tablet designed for 12 month slow release. 12-8-8 NPK, 20% humus, 4% humic acids, 3.5% sulfur, 2% iron, micronutrients.

2.4 PLANT MATERIAL:

- A. Plants shall be in conformance with the California State Department of Agriculture's regulation for nursery inspections, rules, and ratings. Plants shall be healthy, vigorous, and free of insect infestations, plant diseases, sunscalds, frostburns, abrasions, or other disfigurement. Plants shall be grown in climatic conditions similar to that of the planting site, and well hardened off. Plants shall have vigorous fibrous root systems which are not rootbound or potbound. The Architect is the sole judge as to acceptability of plant material.
- B. The size of the plants will correspond with that normally expected for species and variety of commercially available nursery stock or as specified on Drawings.
- C. The Architect shall approve plant material prior to planting. Plants shall be subject to review and approval of Architect at place of growth or upon delivery for conformity to specifications, and for injury, insect infestation, and trees and shrubs for improper pruning. Such approval shall not impair the right of review and rejection during progress of the work. Architect reserves the right to refuse review if, in his/her judgment, a sufficient quantity of plants is not available for review.
- D. Plants not conforming to the requirements herein specified shall be considered defective, and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site and replaced with new plants at the Contractor's expense.
- E. Plant material shall be true to botanical and common name and variety as specified in "Sunset Western Garden Book."
- F. Substitute plant material will not be permitted unless specifically approved in writing by the Architect.

2.5 GUYING AND STAKING MATERIALS:

- A. Wood tree stakes: Lodgepole pine, fully treated with CuNap, ACQ or other non-arsenic wood preservative. Do not use split stakes.
 - 1. 24" box trees and smaller: 2" (nom.) diameter by 10' long.
 - 2. 36" box trees: 3" (nom.) diameter by 12' long.
- B. Pipe tree stakes: Schedule 40 steel pipe, 1-1/2" diameter with cap, primed and painted before installation with two coats flat black exterior enamel. Touch up in field to match shop condition.
- C. Tree Ties:
 - 1. Flexible vinyl tree ties meeting ASTM-D-412 standards for tensile and elongation strength. Material shall be black.
 - 2. Each tie shall be a single piece, not multiple ties joined together.

3. Manufacturers: VIT Cinch Tie, VIT Cinch Belt (larger trees), Villa Root Barrier E-Z Band, or equal.

2.6 WATER:

- A. Furnished by Owner.
- B. Transport by Contractor as required.

2.7 MULCH:

- A. Decorative Bark:
 1. Walk-On-Bark as supplied by Sequoia Forest Products, telephone: (559) 591-1177.
 2. Small Bark product #083 by Kellogg Supply, Inc., telephone: (310) 830-2200.
 3. Small Deco Bark by Aguinaga Fertilizer Company, (949) 786-9558.
- B. Composted, shredded tree trimmings:
 1. Forest Floor 0-2" by Aguinaga Fertilizer Company, (949) 786-9558.
- C. Submit mulch samples for approval by Architect. No shredded lumber products will be accepted.
- D. Rock mulches: per Plans.

2.8 METAL EDGING:

- A. Steel edging shall be 3/16" x 5 1/2", black color, with 18" steel stake.
 1. Manufacturer: Sure-Loc. (800) 787-3562.

2.9 DRAINAGE MATERIAL

- A. 3/8" crushed rock:
 1. 95% -100% passing through a 3/8" screen.
 2. 0-5% passing through No. 8 mesh.
 3. 80-100# per cubic yard.

2.10 SOIL SEPARATOR:

- A. Nonwoven polypropylene fabric, needle-punched, with UV Resistance of 70%, AOS of 70 US Standard sieve, water flow rate of 110 gpm/ft².
 1. Geotex 701, manufactured by Propex, or equal.

2.11 WEED CONTROL FABRIC

- A. Spun-bonded polypropylene with UV inhibitors, non-degrading geotextile fabric that blocks 95% of weed growth and is permeable to air, water, gasses and fertilizer. Typar 3301 or equal.
- B. Properties:

1. Unit Weight: 3.0 oz/yds²
2. Tensile Strength: 135 pounds
3. Puncture Strength: 35 pounds
4. Air Opening Size: 60/70 equivalent sieve
5. Elongation at Break: <70%
6. Trap Tear: 50 pounds
7. Flux: 70 gal/ft²/min
8. Permittivity: 1.2 sec⁻²
9. Color: Black

2.12 ROOT BARRIER

- A. Polyethylene (0.08 inch thick) or polypropylene (2.032 - 2.16 mm thick), with self-locking joiners, ½" raised 90 degree molded root deflecting ribs, ground lock tabs, double top edge, UV inhibitors. Use 24" barrier unless otherwise stated.
- B. Bamboo root barrier: 0.76mm thick, minimum, polyethylene. Use 36" wide barrier unless otherwise stated.

2.13 TREE TRUNK PROTECTOR

- A. 9" height with 4" diameter, expandable, ventilated, 1.52 mm thick UV inhibited polyethylene, gray-brown color. Arbor Guard by Deep Root Corp (800) 458-7668. TP-128 by NDS (800) 726-1994, or equal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

- A. Site acceptance:
 1. The Contractor shall be responsible for coordinating his work with the General Contractor and other Sub-Contractors so no damage occurs to plantings after installation.
 2. The Contractor shall be responsible for verifying grades and site conditions before beginning work. No change in Contract price will be owed for actual or claimed discrepancy between existing grade and those shown on the plan after Contractor has accepted existing grades and moved on the site.
- B. Scheduling: Perform planting only when weather and soil conditions are suitable, as approved by Architect.
- C. The irrigation system shall be operational and approved prior to planting.
- D. Utilities: Prior to excavation for planting or installation of stakes or guys, Contractor shall locate utility lines and cables, so that proper precautions will be taken not to damage them. In the event of a conflict between utility lines and plant locations, promptly notify the Architect, who shall arrange for the relocation of one or the other. Failure to follow this procedure shall make the Contractor responsible for repairing damages at his own expense.

- E. Waterproofing: Verify that waterproofing is complete and water-tight in over-structure planters.

3.2 SOIL PREPARATION:

A. Planting Areas:

1. Uniformly spread amendments and thoroughly cultivate by means of mechanical tiller per Soils Report.
2. Use nutrients recommended in the Soil Report.
3. Add the appropriate Mycorrhizal inoculum and incorporate at manufacturer's recommended rate.
4. Perform soil preparation after irrigation is installed and tested, and prior to planting.

B. Final Grades and Planting Area Layout:

1. At time of planting, the top two (2) inches of areas to be planted or seeded shall be free of stones, sticks, stumps, or other deleterious matter one inch in diameter or larger. It shall also be free from wire, plaster, construction debris, or similar objects that would be a hindrance to planting or maintenance.
2. Contractor shall be responsible for shaping planting areas as indicated on Plans or as directed by Architect.
3. Minor modifications to grade may be required to establish the final grade. Remove soil generated by excavations to an approved off-site location unless said soil can be utilized to obtain desired grade.
4. Finish grading shall insure proper drainage of the site as determined by the Architect.
5. Areas shall be graded so that the final grades will be 1-1/2" below adjacent paved areas, sidewalks, valve boxes, headers, cleanouts, drains, manholes, etc. or as indicated on Plans.
6. Surface drainage shall be away from building foundations.
7. Eliminate erosion scars prior to commencing maintenance period. Depressions due to settling shall be eliminated before and after planting.
8. Slopes of two to one (2:1) or steeper shall be protected with erosion control fabric. Contractor shall request clarification from Architect for fabric and methods.

C. Compacted Soil / Percolation Testing: Soil may be heavily compacted which can hinder root development, drainage and aeration.

1. Severely compacted areas shall be ripped or tilled to a depth of at least 9" prior to planting.
2. Percolation tests of water through the soil shall be performed where trees 24" box size and larger are proposed. If trees are to be planted over a large area, several percolation tests will be required.
 - a. Excavate two planting pits 24" deep by 2 times rootball diameter. Install sand filled drainage sump as specified in 3.3.D.4, below, in one of the pits.
 - b. Fill the pits with water and allow to drain completely.
 - c. Fill the pits with water a second time.
 - d. Results:
 - 1) If the pit with no sump drains completely within 24 hours, no drain sump is necessary for trees planted within the vicinity of the test pit.

- 2) If the pit with no sump does not drain completely within 24 hours, but the pit with the sump does, sumps are required for trees planted in the vicinity of the test pit.
- 3) If the pit with the sump does not drain completely within 24 hours, advise the Owner prior to planting.

D. Pre-Plant weed Control:

1. "Grow & Kill": If weeds exist on site at the beginning of work, spray with a non-selective systemic contact herbicide, recommended by an approved licensed landscape Pest Control Advisor and applied by a licensed Pest Control Operator. Leave sprayed plants intact to allow systemic kill as directed by Advisor. After recommended kill period, water thoroughly to encourage new weed growth, and re-apply systemic herbicide.
2. Treat planting areas, except for those to be seeded, with pre-emergent herbicide, recommended by an approved licensed landscape Pest Control Advisor and applied by a licensed Pest Control Operator
3. Maintain site weed free until final acceptance by Owner by utilizing mechanical, manual, or chemical treatment.

E. Slope Stabilization

1. Slopes greater than 3:1 are to be stabilized with jute mesh.
2. Prepare soil as noted above.
3. Unroll jute from top of slope to bottom. Secure at top of slope by toeing jute in 6" deep. Reinforce with a row of at least five staples, spacing each about a foot apart, and covering with soil.
4. Place staples 18" to 24" apart throughout to secure matting to ground. Staples must be driven flush with soil surface.
5. Overlap edges of rolls 6", minimum. Securely staple the two layers to the ground.
6. Install jute mesh loosely - do not stretch.
7. Check slots may be needed on steep slopes to prevent subsurface erosion.
 - a. Dig 6" deep trench perpendicular to water flow.
 - b. Drop two or three folds of fabric in the slot.
 - c. Staple fabric securely in bottom of trench, and continue rolling down hill.
8. Use approximately 200 staples per 100 square yards of fabric.

3.3 PLANTING

- A. Planting Layout: Plant layout is to be approved by Architect before planting begins. Layout of trees and major plantings shall be approved first. One tree with each type of specified staking shall be approved prior to planting of trees. Bring conflicts regarding the exact locations of plant pits to the attention of Owner's representative and Architect. If underground utility lines or other unknowns are encountered in excavation for planting, alternate locations for planting may be selected by the Architect. It is the Contractor's responsibility to verify with the Owner's superintendent and governing agencies the location and depth of underground utilities.
- B. Planting of Trees and Shrubs (at grade):
1. Do not plant rootbound, dried out, undersized, or damaged plants.
 2. Install trees, shrubs, and groundcovers before planting seed or sod.

3. Excavated holes shall have vertical sides with roughened surfaces and shall be twice the diameter and the depth of the root b.
4. Drainage: Drainage sumps are to be provided in each tree pit. Drain sumps (12-inch diameter by 6 feet deep) may be augured. Sump is to be filled with coarse sand. Planting may proceed after sump installation.
5. Fill excavations with water and allow to percolate out, before positioning trees and shrubs.
6. Install root control barriers where indicated on Plans and where site conditions (trees within three feet of pavement) dictate. Install per manufacturer's instructions.
7. Center plant in pit or trench. Remove boxes and cans without damage to rootball. Add the appropriate Mycorrhizal inoculum next to rootball at manufacturer's recommended rate. Set plant plumb and hold rigidly in position until soil has been dampened firmly around b or roots. An earthen basin shall be constructed around each plant. Each basin shall be of a depth sufficient to hold at least two inches (2") of water. Remove basin in turf areas after initial watering. Plants that settle deeper than the surrounding grade shall be raised to surrounding grade level.

- C. Planting Tablets: Place the following numbers of 7-gram planting tablets within the backfill of each plant:

Container size / Number of tablets

1 gallon	3
5 gallon	8
15 gallon	12
24" box	16
36" box	24
48" box	32

- D. Staking and Guying: Staking and Guying of trees shall be completed immediately upon planting. Stakes shall be installed plumb and as indicated in details. Guy locations and methods shall be reviewed prior to planting of boxed trees. Bring conflicts of locating guys or stakes to the attention of Architect. Remove nursery stakes when site stakes have been installed.
- E. Ground covers: Ground covers or seedlings shall be planted in straight rows and evenly spaced, unless otherwise noted, and at intervals called out in the drawing. Triangular spacing shall be used unless otherwise noted on the drawing. Fill in bare areas with plants at the required spacing. Damage to plants by trampling or other work in this contract shall be repaired immediately.
- F. Sod Planting:
1. Preparing Soil: Remove rocks or sticks from area to be sodded. Prepare soil as noted elsewhere in specifications and break up clods.
 2. Grading and Rolling: Carefully smooth surfaces to be sodded. Roll area in two directions to expose soil depressions or surface irregularities, then re-grade and re-roll soil as required producing a firm smooth surface. Be sure soil is level, smooth, and moist (not wet) before laying sod. Avoid laying sod on hot or extremely dry soil.
 3. Laying Sod: Lay first strip of sod slabs along a straight line (use a string in irregular areas). Butt joints tightly. Do not overlap edges. On second strip, stagger joints (as with

laying brick). Use a sharp knife to cut sod in order to fit curves, edges, and sprinkler heads.

4. Watering During Planting: Do not lay whole lawn before watering. When a large area has been sodded, water lightly to prevent drying. Continue to lay sod and water until installation is complete.
5. Rolling Sod: After laying sod, roll lightly to eliminate irregularities and to form good contact between sod and soil. Avoid heavy roller or excessive initial watering which may cause roller marks.
6. Irrigation: Water the completed lawn surface thoroughly. Soil should be moistened at least eight inches deep. Repeat sprinkling at regular intervals to keep sod moist until rooted. After sod is established, decrease frequency and increase amount of water per application as necessary.
7. Replacement: Replace dead or dying sod with equivalent material as directed by Architect.

G. Mulch covers:

1. Complete planting and finish grades before placing mulch.
2. Place mulch material in a continuous layer 3" deep adjacent to plant crown in shrub and groundcover areas, and in areas between shrubs.
3. Place mulch in a 2" deep layer in areas with flatted groundcover and annual color.
4. Install special mulches (glass, rock) over weed control fabric.
 - a. Overlap fabric a minimum of 8".

H. Install Arbor-gard tree trunk protector on trees planted in turf areas. Install per manufacturer's instructions.

3.4 CLEANUP

- A. Untie palm fronds after planting, if twine has not broken, according to the following schedule:
 1. Queen palms (field dug): 60 days
 2. Queen palms (boxed): immediately after planting
 3. Washingtonia palms: 30 days
- B. After planting operations have been completed, remove trash, excess soil, empty plant containers, and rubbish from the property, and dispose of legally.
- C. Cleanup shall be performed at the end of each working day, with a maximum cleanup effort (in a manner satisfactory to the Owner) for each weekend or Holiday.
- D. The Contractor shall sweep the site and shall wash down pavement within the Contract area, leaving the premises in a clean condition.
- E. Walks shall be left in a clean and safe condition.
- F. Scars, ruts, or other marks in the ground caused by this work shall be repaired and the ground left in a smooth condition throughout the site.

END OF SECTION 32 90 00

SECTION 33 10 00
SITE WATER UTILITIES

WATER SERVICE NOTE: WATER SERVICE MUST BE MAINTAINED TO ALL USERS WITHIN THE CONSTRUCTION AREA AT ALL TIMES. IF THE PRIMARY SOURCE OF WATER IS INTERRUPTED, A TEMPORARY SECONDARY SOURCE SHALL BE SUPPLIED BY THE CONTRACTOR, APPROVED BY THE LOCAL WATER DEPARTMENT. ANY EXPENDITURES INCIDENTAL THERETO SHALL BE BORNE BY THE CONTRACTOR. THE WATER SHALL BE SAFE FOR DRINKING IN ACCORDANCE WITH PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS.

PART 1 - GENERAL

1.01 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to domestic & fire water systems serving all buildings and appurtenances. Unless otherwise noted, this section does not apply to irrigation systems and water systems inside buildings and within 2 feet of buildings.
- B. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing and piping and including the demolition and removal of certain equipment, piping and appurtenances all as required and 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.
- C. Section Includes:
 - 1. Piping and specialties for underground domestic water outside the buildings.
 - 2. Trenching Requirements: Conform to the requirements of Section 31 20 00 – Earthwork.
 - 3. Hydrostatic Pressure, Leakage & Disinfection Testing.

1.02 SUBMITTALS

- A. Product Data: Manufacturer’s catalog data for materials. Include technical data for piping, gaskets, joints and couplings, ball valves and valve boxes.
- B. Certificates: Certificates attesting that tests set forth in referenced publications have been performed and the performance requirements have been satisfied.

1.03 LICENSES, PERMITS & FEES

- A. The Contractor installing the water lines shall have a Class “C-34”, “C-36” or Engineering “A” Contractors license valid in the State of California.
- B. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for

the construction of the work. The Owner shall reimburse the contractor for all necessary permits or inspection fees by any legally constituted agency.

1.04 QUALITY ASSURANCE

- A. California Plumbing Code, CPC, 2016 Edition.
- B. Comply with the following as a minimum requirement:
 - 1. ANSI:
 - a. ANSI B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - b. ANSI B18.5.2.1M Metric Round Head Short Square Neck Bolts.
 - 2. ASTM:
 - a. ASTM A 47 Ferric Malleable Iron Castings.
 - b. ASTM A 48 Gray Iron Castings.
 - c. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - d. ASTM A 307 Carbon Steel bolts and Studs, 60,000 psi Tensile Strength.
 - e. ASTM A 563 Ductile Iron Castings.
 - f. ASTM A 563 Carbon and Alloy Steel Nuts.
 - g. ASTM B 61 Steam or Valve Bronze Castings.
 - h. ASTM B 62 Composition Bronze or Ounce Metal Castings.
 - i. ASTM B 88 Seamless Copper Water Tube.
 - j. ASTM C 94 Ready-Mixed Concrete.
 - k. ASTM D 1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.
 - l. ASTM D 1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - m. ASTM D 2235 Solvent Cement for ABS Plastic Pipe, and Fittings.
 - n. ASTM D 2241 PVC Plastic Pipe Fittings, Schedule 40.
 - o. ASTM D 2282 ABS Plastic Pipe.
 - p. ASTM D 2466 PVC Plastic Pipe Fittings, Schedule 40.
 - q. ASTM D 2468 ABS Plastic Pipe Fittings, Schedule 40.

- r. ASTM D 2564 PVC Plastic Piping Systems.
 - s. ASTM D 2774 Underground Installation of Thermoplastic Pressure Piping.
 - t. ASTM D 2855 Making Solvent-Cemented Joints with PVC Pipe and Fittings.
 - u. ASTM D 3139 Joints Pressure Pipes Using Flexible Elastomeric Seals.
 - v. ASTM F 402 Safe Handling Of Solvent Cements, Primer and Cleaners Used for Joining Thermoplastic Pipes and Fittings.
 - w. ASTM F 477 Elastomeric Seals for Joining Plastic Pipes.
3. American Water Works Association (AWWA) Standards:
- a. AWWA C104/A21.4 Cement-Mortar Lining For Ductile-Iron Pipe and Fittings For Water
 - b. AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids.
 - c. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron pressure Pipe and Fittings.
 - d. ASTM C151/A21.51-96 Ductile-Iron Pipe, centrifugally cast, for water 3 inches through 64 inches.
 - e. AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3 inches through 16 inches, for Water and Other Liquids.
 - f. AWWA C500 Gate Valves for Water and Sewerage Systems.
 - g. AWWA C503 Wet- Barrel Fire Hydrants.
 - h. AWWA C508 Swing-Check Valves for Waterworks Service, 2 inches through 24 inches NPS.
 - i. AWWA C509 Resilient-Seated Gate Valves for Water and Sewerage Systems.
 - j. AWWA C511 Reduced-Pressure Principal Backflow-Prevention Assembly.
 - k. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - l. AWWA C651 Disinfecting Water Mains.
 - m. AWWA C800 Underground Service Line valves and Fittings.

- n. AWWA C900 PVC Pressure Pipe, 4 inches through 12 inches, for Water Distribution.
- o. AWWA M23 PVC Pipe - Design and Installation.
- 4. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:
 - a. MSS-SP-80 Bronze Gate, Globe, Angle and Check Valves.
 - b. MSS-SP-73 Silver Brazing Joints for Wrought and Cast Solder-Joint Fittings.
- 5. Uni-Bell PVC Pipe Association (UBPPA):
 - a. UBPPA UNI-PUB-9 Installation of PVC Pressure Pipe.
 - b. UBPPA UNI-B-13 Standard Performance Specification on joined restrained devices for use with Poly Vinyl Chloride (PVC) Pipe.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate with other utility work.

1.06 PRODUCT HANDLING

- A. Store items above ground on platforms, skids or other approved supports.
- B. Deliver piping 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.
- C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- D. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use hand wheels or stems as lifting or rigging points.
- E. Protect coating and linings on pipes, fittings and accessories from damage. Do not drag pipe to trench. Repair coatings or linings damaged.

1.07 DISPOSAL OF REMOVED MATERIALS INCLUDING ASBESTOS-CEMENT PIPE

- A. All removed materials, except those indicated on the plans or described herein to remain the property of the Owner, shall become the property of the Contractor and shall be disposed in accordance with local, state, and federal laws. Should any of those materials be considered as hazardous the Contractor shall provide the Owners Inspector with paper custody trail documentation of the disposal.
- B. Asbestos – Cement (A-C) Pipe Removal and Disposal: The plans for the project may indicate that existing asbestos-cement pipe is to be removed from the ground. Where so indicated the Contractor shall excavate as specified in 312200, expose the pipeline

and remove the A-C pipe to the nearest joint. Should the plans not call out the removal of the A-C pipe and A-C pipe is encountered, the Contractor shall obtain approval from the Inspector as to whether or not the A-C pipe is to be removed or can be left in place. Cutting of the pipe shall only be done if absolutely there is no other way to expose the length of pipe to the nearest joint that be separated and the Inspector approves the cutting of the pipe. Cutting of the pipe shall be done with a mechanical saw with a pressure water source to dampen the pipe and the dust from the cutting. To remove a coupling, the coupling may have to be broken in the trench. The pipe once removed from the trench may be broken for handling. The breaking shall be done within a plastic bagging or sheeting material to minimize the release of asbestos fibers into the atmosphere. Once removed and broken, if necessary, the A-C material shall be bagged and disposed of legally with the Inspector to be given a copy of all Contractor paperwork as to the legal disposal of the material. If the A-C pipe section(s) are removed intact the pipe can be removed by the Contractor from the project site and become the property and responsibility of the Contractor.

1.08 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, 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 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 acceptance. Only when Architect's acceptance is given, in writing, shall Contractor proceed with installation of the work.
- C. In case of a difference in the specifications or drawings, or between the specifications and the drawings or in the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.09 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.

1.12 SUBMITTAL DATA

- A. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to put identification numbers on fixtures and equipment schedules.
- B. Manufacturer's 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.
- C. 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.
- D. A list of names is not a valid submittal. To be valid, all submittals must:
 - 1. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - 2. Include all pertinent construction, installation, performance and technical data.
 - 3. Have all copies marked to indicate clearly the individual items being submitted.

4. Have each item cross-referenced to the corresponding specified item and be marked to show how differences will be accommodated.
5. Contain calculations and other detailed data justifying how the item was selected for proposal. Data must be completed enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
6. 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 alternate.
7. In addition to the material and equipment submittals, the Contractor shall provide shop drawings of all underground utilities complete with all appurtenances and indicate exact location by dimension to grading plan, submit for review prior to installation.

1.13 INSPECTION

- A. Notice shall be given to the Owner's Inspector at least 48 hours before starting construction.
- B. Contractor shall not allow or cause any of his work to be covered up before it has been duly inspected, tested and approved by the Owner, Architect or any other authorized inspectors having legal jurisdiction over his work. Should he fail to observe the above, he shall uncover the work and, after it has been inspected, tested and approved, recover it at his own expense.
- C. Inspection of the work shall not relieve the contractor of any obligations to complete the work as prescribed by the standard specifications. Any known defective work shall be corrected before testing or final inspection will be permitted. Unsuitable materials may be rejected even if these materials have been previously overlooked by the Inspector.
- D. The Owner shall have the authority to suspend the work completely or in part for such time as it may deem necessary if the contractor fails to carry out instructions given by the Owner, or to perform any required provisions of the plans and specifications. The contractor shall immediately comply with a written order of the Owner to suspend the work completely or in part. The work shall be resumed when improper methods or defective work are corrected as ordered and approved in writing by the Owner.

1.14 SUBSTITUTIONS

- A. The Contractor assumes full responsibility that alternate manufacturers, 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 which 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 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.

- B. This Contractor is responsible 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.
- C. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials and decisions of the Architect or that of his representative shall be final and conclusive.

1.15 RECORD DRAWINGS

- A. Contractor shall provide and keep up-to-date a complete "as-built" record set of redline 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. 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.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pipe:
 - 1. Water Distribution Main (pipe size 4 inches and larger).
 - a. Ductile Iron Pipe (DIP): Pressure Class 350 pipe conforming to AWWA/ANSI C151/A21.5, cement-mortar lining conforming to AWWA/ANSI C104/A21.4, with standard thickness per AWWA/ANSI C150/A21.50. U.S. Pipe, American Cast Iron Pipe Company (ACIPCO), or approved equivalent.
 - b. Polyvinyl Chloride Pipe (PVC): Pressure Class 235, DR 18, spigot and gasket bell end, conforming to AWWA C900, with equivalent cast-iron pipe outer diameter (O.D.). Acceptable manufacturers: J-M Manufacturing Blue Brute, Vinyl Tech, Diamond Plastic, PW Pipe, or approved equal.
 - 2. Domestic Water Pipe Schedule 80 PVC: Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 80, meeting ASTM D 1785 standards.
- B. Fittings:

1. Domestic Water Pipe Poly Vinyl Chloride (PVC) Water fittings shall conform to ASTM D 2467 "Socket-Type" PVC Plastic Type Fittings, Schedule 80.
 2. All fittings for Iron Pipe Size pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Fittings shall be Class 315 and conform to requirements of SDR 13.5. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F., tested in accordance with ASTM D1599.
 3. Ductile Iron: Ductile iron fittings shall be supplied in accordance with AWWA Standard C110, Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. for Water and Other Liquids", or AWWA Standard C153, "Ductile Iron Compact Fittings, 3 In. Through 24 In for Water Service". All fittings shall have mechanical joints unless otherwise specified on Construction Plans.
 - a. Mechanical joints shall conform to the requirements of AWWA Standard C111, "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings."
 - b. Flanged fittings shall conform to the requirements of AWWA Standard C110 or C153. Flanges shall be drilled to ANSI B16.1, 125 lb standard bolt template. The 250 lb. Flanges, when required, shall be drilled to ANSI B16.1, 250 lb. standard bolt template.
 - c. Where restrained joints are indicated on the plans, push-on "Tyton" joints shall be restrained with "Field-Lok" gaskets as manufactured by U.S. Pipe or approved equal.
 - d. Ductile iron pipe fittings shall be manufactured or supplied by American Ductile Iron Pipe (a division of American Cast Iron Pipe Company, Birmingham, Alabama), U.S. Pipe & Foundry Company, Tyler Pipe/Union Foundry, Griffin Pipe Products Company, Sigma Corporation, Star Pipe Products Co., or approved equal.
- C. Gaskets for Ductile Iron Pipe:
1. Gaskets for Ductile Iron Pipe: Gaskets for flanged joints shall be full faced, cut from 1/8 inch thick Nitrile Rubber (Buna-N), bolt holes pre-punched, conforming to the requirements of ANSI /ASME B16.2.1. Gaskets shall be manufactured or supplied by Tripac Fasteners, Long Beach Industrial Gaskets, or approved equal.
- D. PVC & Mechanical Pipe Couplings, Joints and Jointing Materials:
1. Pipe joints on plastic pipe 3-inch and under shall be solvent cement joints conforming to ASTM D 2564, primer according to ASTM F 656. Solvent and primer shall not be more than one year old.
 2. All couplings shall be manufactured from the same materials and in compliance with the specifications set forth herein before for PVC pipe.
 3. PVC C-900 Pipe: joints shall be integral, bell and spigot gasketed joints.

- a. Provide each PVC C-900 Pipe joint connection with an elastomeric gasket suitable for the bell or coupling installation.
 - b. An elastomeric gasket shall be designed with a retainer ring which “locks” the gasket into integral bell groove and shall be installed at the point of manufacturer. Gasket shall be in conformance with ASTM F477.
 - c. Gaskets for push on joints and compression type joints or mechanical joints for connections between pipes and metal fittings, valves, and other accessories shall be as specified in AWWA C111/A21.11.
 - d. Solvent weld joints are NOT PERMITTED.
4. Joints between pipe and metal fittings, valves, and other accessories shall be mechanical joints as specified in AWWA C111/A21.11 unless otherwise noted on Construction Documents.
- E. Lining and Coating for Ductile Iron & Fittings:
1. The interior of all ductile iron pipe and fittings shall be factory cement mortar lined in accordance with AWWA Standard C104. Lining materials shall conform to ASTM C-150, Type II.
 2. All buried ductile iron pipe and fittings shall have a factory applied bituminous coating of not less than 1 mil in thickness as specified in AWWA C151. The coating shall be free from blisters and holes; shall adhere to the metal surface at ambient temperatures encountered in the field.
 3. Cement mortar lining and bituminous coating of pipe or fittings in the field is not permitted.
- F. Bolts and Nuts for Mechanical Joints, Flanged Fittings, Flexible Couplings & Restraint Devices:
1. All bolts and studs shall be Type 316 Stainless Steel per ASTM A193 Grade B8M, project ends of bolts $\frac{1}{4}$ to $\frac{3}{8}$ inch beyond nut.
 2. All nuts and washers shall be Type 316 Stainless Steel per ASTM A194 Grade 8M, provide 1 washer per nut.
 3. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with a mastic, Minnesota Mining and Manufacturing EC 244, Koppers Bitumastic (Super-Tank) 505, or an approved equal.
 4. Stainless steel parts shall not be coated except for the threaded portion, which will be assembled with a liberal coat of anti-seize compound.
 5. All bolts shall be lubricated with anti-seize compound.
- G. Valve Boxes, Risers and Lids for Buried Valves:

1. Valve boxes and cover shall be as shown on Construction Documents.
 2. Valve riser material, where applicable, shall be 10-inch Schedule 80 PVC, or 10-inch SDR 35 PVC pipe
 3. Paint domestic water valve box lids on school property with 2 coats of blue enamel.
 4. Valve boxes shall be marked "WATER" embossed above surface.
- H. Thrust Restraining Materials: All pipe bends and tees 2.5-inches and greater shall be restrained from movement by either the use of concrete thrust blocks or mechanical joint restraints. Restraint systems to be used on PVC C-900 pipe shall meet or exceed A.S.T.M. Standard F1674-96, "Standard Test Methods for Joint Restraint Products for Use with PVC Pipe," or the latest revision thereof. Restraint systems used on ductile pipe shall meet or exceed U.L. Standard 194. Underwriter Laboratories (U.L.) and/or Factory Mutual (FM) certifications are required on all restraint systems. All mechanical restraint devices shall be wrapped with 3 layers of 8-mil polyethylene after assembly.

1. Mechanical Joint Fittings:

- a. Restrainer mechanism shall be integrated into the design of the follower gland. As the mechanism is activated, multiple wedging action shall be imparted against the pipe increasing its resistance as internal pressure increases. After burial of the restraining mechanism, joint flexibility shall be maintained. The actuating bolt shall be threaded into the restraining wedge and have a 1-1/4" across the flats hex head. The actuating bolt system shall have a torque-limiting head designed to break off at preset torque levels, thus insuring proper action of the restraining device. After removal of the torque-limiting head, a 1 1/4" hex head shall remain to facilitate the removal and re-assembly of the gland. Glands shall be manufactured of high strength ductile iron in accordance with ASTM A536, Grade 65-45-12 requirements. Wedge mechanisms shall be heat-treated ductile iron, hardened to at least 370 BHN hardness. The restraining mechanism shall have a pressure rating equal to that of the pipe on which it is used and shall have a safety factor of at least 2:1. The restraining gland shall conform to the requirements of ASTM F 1674, and UNI-B-13-94, "Recommended Performance Specification For Joint Restraint Devices For Use With Polyvinyl Chloride (PVC) Pipe."
- b. The following qualified product list identifies specified manufacturers models approved for installation in this water distribution system:

Manufacturer	PVC C-900 Pipe	Ductile Iron Pipe
EBBA Iron Sales, In	2000 PV	Megalug 1100
Romac Industries, In	Romagrip PVC	Romagrip DI
Star Pipe Products	Stargrip 4000	Stargrip 3000
Uni-Flange Corporation	Series 1500	Series 1400

2. Bell and Spigot Harness:

- a. Restraint Devices for bell and spigot joints of PVC Pipe shall consist of split restraint rings, one installed on the spigot, connected to one installed on the pipe barrel behind the bell. The restraint devices shall incorporate a series of machined serrations (not “as cast”) on the inside diameter to provide positive restraint, exact fit, 360° contact and support of the pipe wall. Restraint Devices shall be of ductile iron, ASTM A536, Grade 65-45-12 and connecting rods shall be of high strength, low alloy material in accordance with ANSI / AWWA C111/A21.11 unless specified as stainless steel in these specifications.
- b. All Restraint Devices shall have a water working pressure rating equivalent to the full rated pressure of the PVC Pipe they are installed on, with a minimum 2:1 safety factor in any nominal pipe size. In addition, they shall meet or exceed the requirements of Uni-B-13-94, “Recommended Performance Specification For Joint Restraint Devices For Use With Polyvinyl Chloride (PVC) Pipe.” Notarized certification from the manufacturer of the restraint device shall be provided with submittals.
- c. The following qualified product list identifies specified manufacturers models approved for installation in this water distribution system:

<u>Manufacturer</u>	<u>PVC C-900 Pipe</u>	<u>Ductile Iron Pipe</u>
EBBA Iron Sales, In	1600 Series	1700 Series
Romac Industries, In	611 Series	611 Series
Star Pipe Products	1100 Series	Not Approved
Uni-Flange Corporation	Series 1390	Not Approved

- 3. Push-On Pipe Bells & Plain End Pipe: Where restrained joints are indicated on the Construction Drawings for ductile iron pipe, push-on joints shall be restrained with “Field-Lok 350” gaskets as manufactured by U.S. Pipe or approved equal. “TR-Flex” restrained joint pipe as manufactured by U.S. Pipe or approved equal is also an acceptable option for restraint of push-on joints. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.

4. Flange Adapters:

- a. Flange Adapters shall be manufactured from ductile iron per ASTM A536, Grade 65-42-12 and shall have bolt circles and bolt holes to meet ANSI B16.1 – Class 125 or Class 250 if required and shown on plans.
- b. The following qualified product list identifies specified manufacturers models approved for installation in this water distribution system:

<u>Manufacturer</u>	<u>PVC C-900 Pipe</u>	<u>Ductile Iron Pipe</u>
EBBA Iron Sales, In	2100 Series	2100 Series

Romac Industries, In	Not Approved	Field Flange
Star Pipe Products	Not Approved	Series 200
Uni-Flange Corporation	Not Approved	Series 200/400/420

5. Concrete: Concrete for thrust blocks shall conform to Concrete Class 520-C-2500. If thrust block is to be disturbed or backfill is to be placed prior to developing its required strength, additional mechanical thrust restraining devices approved by the Civil Engineer shall be installed.
- I. Tracer Wire for Nonmetallic Pipes: Tracer wires shall be electrically continuous #14 soft drawn copper wire, Type TW, blue plastic covered for potable water and red for fire water. Provide in sufficient length to be continuous over each installed section of nonmetallic pipe.
 - J. Polyethylene Encasement Film Wrap: All ductile iron pipe and fittings buried underground shall be protected with double wrapped plastic film in accordance with AWWA C105 "American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems" and each wrap shall be a minimum thickness of 0.008 in. (8 mils). All joints between plastic tubes shall be taped and secured with general purpose polyethylene tape, 2 inches wide and 10 mils thick (Scotchrap No. 50, Plicoflex No. 340, Protecto Wrap No. 200, Polyken No. 900, or approved equal).
 - K. Sleeve-type Flexible Transition & Flanged Couplings:
 1. Sleeve-type couplings shall be in accordance with ANSI/AWWA C219 - Standard for Bolted Sleeve-type couplings for Plain-End Pipe, and shall be of stainless steel or ductile iron with stainless steel bolts, without pipe stop, and be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 12 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.
 2. Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer.
 3. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D2000 - Classification System for Rubber Products in Automotive applications, AA709Z, meeting Suffix B13 Grade 3. All gaskets shall be compatible with the piping service and fluid utilized.
 4. Bolts, nuts, & washers for couplings shall meet the requirements listed in Section 2.1K, herein. All cast components shall be fusion bonded epoxy coated

per AWWA C213. After installation couplings shall be wrapped with 8-mil polyethylene wrap per AWWA C-105 and section 2.1M requirements listed herein.

5. Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket, which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
6. All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the AWWA M11 standard, or as indicated.
7. The following qualified product list identifies specified manufacturers models approved for:

Straight & Transition Couplings

Romac Industries, Inc.:	Style "501"
Ford Meter Box Co.:	Style "FC1" or "FC2A"
Smith-Blair:	400 Series
JCM Industries:	200 Series
Dresser	Style 62 or 162

Flanged Coupling Adapters

Romac Industries, Inc.:	Style "FCA 501" or "FC400"
Ford Meter Box Co.:	Style "FFCA"
JCM Industries:	300 Series
Smith-Blair:	Style "913"
Dresser	Style 227

PART 3 - EXECUTION

3.01 CLEARANCES OF WATER LINE

- A. Buildings: 3 feet.
- B. Parallel to Sewer Line:
 1. Water lines 4 inches or less in diameter shall not be installed in a common trench with the building sanitary drain unless the bottom of the water line is at least 12 inches above the top of the building sanitary drain or where the water line is installed on a solid shelf excavated on one side of the common trench with a minimum clear horizontal distance of 12 inches from the building sanitary drain.
 2. Water mains larger than 4 inches in diameter shall be separated from the Project site sanitary sewer, receiving more than one building sanitary drain or

acid pipeline, in accordance with the requirement of the State of California, Human and Welfare Agency, Department of Health Services.

- C. Crossing Sewer Line:
1. A water main shall be separated from sanitary sewer in accordance with the requirements of the State of California Administrative Code, Title 22, Section 64630(e)(2), unless modified herein.
 2. Install water main a minimum of 12 inches clear, above or below a sanitary sewer.
 3. A water main greater than 4 inches in diameter, crossing under a sanitary sewer line, shall be installed with all their joints located at least 10 feet away from each side of the sanitary sewer line.
 4. A water main greater than 4 inches in diameter, crossing over a sanitary sewer line, shall be installed with all their joints located at least 5 feet away from each side of the sanitary sewer line.
- D. Install all water mains no closer than 10 feet horizontally clear from the edge of sewage leach fields, seepage pits and septic tanks.

3.02 LAYING OF PVC PRESSURE PIPE

- A. Installations of pipe, bends, and fittings shall be in accordance with Section 3.3 for ductile iron bends and fittings and AWWA C-605, "Underground Installation of (PVC) Pressure Pipe and Fittings for Water" and/or the Uni-bell guideline UNI-PUB-9, "Installation Guide for PVC Pressure Pipe". PVC bends and fittings are not allowed. The Uni-Bell Handbook of PVC Pipe-Design and Construction shall be used for details of pipe installation practice except as follows and where noted otherwise on plans. Longitudinal bending of pipe sections is prohibited. Any directional change shall be accomplished through manufacturer approved 1 degree deflection of push on joints, 5 degree deflection with Certainteed – couplings, or ductile iron bends capable of withstanding 250 psi loads. A number 14 gauge, solid, soft drawn insulated copper tracer wire is required for PVC pipe installation. The tracer wire shall be wrapped around the pipe at 10-foot intervals and brought up inside each valve can to within 6 inches of the valve cover.
- B. Acceptable line and grade for piping: The pipe shall be laid true to the line and grade shown on the plans within acceptable tolerances. The tolerance on grade is 1 inch. The tolerance on line is 2 inches.
- C. A number 14 gauge, solid, soft drawn insulated copper tracer wire is required for PVC pipe installation on lines 2" and greater. The tracer wire shall be wrapped around the pipe at 10-foot intervals and brought up inside each valve can to within 6 inches of the valve cover.
- D. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting soil into it, the Engineer may require that before

lowering the pipe into the trench, a temporary plug be placed over each end and left there until the connection is to be made to the adjacent pipe. During the laying operations, no debris, tools, clothing or other materials shall be left in the pipe.

- E. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug or other means approved by the Inspector. This provision shall apply during the lunch-hour breaks as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.
- F. The cutting of pipe for inserting tees, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. The beveled end of any PVC pipe shall be cut off before the pipe is inserted into a mechanical joint bend or fitting. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable.
- G. Should structural difficulties or Work of other trades prevent the running of pipes or the setting of equipment as indicated by Drawings, the necessary deviation will be allowed by the Owner's Inspector.
- H. All water piping shall be adequately supported. Burred ends shall be reamed to the full bore of the pipe or tube. Change in direction shall be made by the appropriate use of fittings. All piping, equipment, appurtenances and devices shall be installed in conformity with the provisions and intent of the California Plumbing Code.
- I. Install piping under streets and other obstructions that cannot be disturbed, by tunneling, jacking, or combination of both.
- J. When connecting plastic pipe to copper, brass, or steel material, provide a schedule 80 PVC nipple.
- K. Cure welded joints at least 15 minutes before moving or handling, and at least 24 hours before applying pressure to system, unless otherwise recommended by joint solvent manufacturer.
- L. Field inspection for plastic pipe and fittings shall follow section 306-1.2.12, Standard Specifications for Public Works Construction, latest edition.

3.03 CONNECTIONS TO EXISTING UTILITIES

- A. All tie-in locations shall be excavated a minimum of TWO (2) working days in advance of final connection to expose the affected portions of existing pipelines and to allow time for the necessary measurements, assembling of materials and equipment, and assuring that all pre-assembled piping and fittings will be compatible with the existing main.
- B. Changes or delays caused by the Contractor's failure to perform "Potholing" and interference location work shall not be eligible for extra work, compensation, or time extension.
- C. The Contractor shall immediately notify the Owner's Inspector in writing, upon learning of the existence or location of any utility facility omitted from or shown incorrectly on

the contract drawings, or improperly marked or otherwise indicated. The Contractor shall provide full details as to depth, location, size and function of the utility in writing to the IOR and note it on the "as-built" plans.

- D. The Contractor shall furnish and place the necessary protection around a utility when protection is called for on the contract drawings, visible to the Contractor, or marked as such. The Contractor shall install the utility protection at no additional expense to the Owner.

3.04 VALVES

- A. Water valves shall be installed at locations shown on the Construction Drawing, or as directed by the Inspector. Valves shall be set plumb, and shall be stabilized and supported separately from the pipeline. Information regarding size, type, make, and number of turns to close shall be supplied to the Utility. All valves shall be covered with a valve box assembly. Valve boxes shall be plumb, centered over the valve nut, and supported separately from the valve body. Valve boxes shall be lowered to below paving grade level prior to street paving, and after final grade has been established by the final grade. In any event, Contractor shall ensure that all valve boxes will provide access to the operation of the valve by the Utilities' personnel. Valve boxes shall be flagged or barricaded during construction to divert traffic around their location.
- B. Wrap buried valves, 2-½ inches and larger, with two layers of 8-mil polyethylene wrap per AWWA C105.
- C. All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly with a mastic, Minnesota Mining and Manufacturing EC 244, Koppers Bitumastic (Super-Tank) 505, or an approved equal.
- D. Stainless steel parts shall not be coated except for the threaded portion, which will be assembled with a liberal coat of anti-seize compound.

3.05 PROTECTION OF METAL SURFACES

- A. All exposed surfaces of the valves, flanges, bolts, nuts, tie-rods, turn buckles, etc. in contact with the earth and backfill materials shall be coated with a minimum of 30 mils of bitumastic coating prior to backfilling. In addition to this bitumastic coating, all iron or steel surfaces such as valves, flanges, bolts, nuts, couplings, shall be encased in 8 mil polyethylene wrapping in accordance with AWWA C105 "American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems".

3.06 ELECTROLYSIS PREVENTION

- A. Insulating (dielectric) couplings or 6-inch long brass nipples shall be installed at locations specified or as required. Dielectric insulators shall be provided to insulate dissimilar metal to metal contact. Flanges shall be provided with a complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at locations indicated or as required.

- B. Where steel or cast iron below grade connects to copper or brass piping above grade, the transition from steel or cast iron pipe to copper or brass pipe shall be installed in an above grade accessible location.
- C. Underground dielectric connections shall be in accessible yard boxes.
- D. Above ground dielectric connections shall be exposed.

3.07 PIPELINE FLUSHING & HYDROSTATIC TESTING

- A. General Requirements
 - 1. Hydrostatic testing and disinfecting (chlorination and flushing) of newly laid or repaired pipelines and appurtenances must be completed before the pipelines can be connected to the existing water distribution system. Pipelines and appurtenances shall remain isolated from the existing water distribution system during hydrostatic testing and disinfecting.
 - 2. All services, air release valves, and other appurtenances connected to the newly laid pipeline shall be pressure tested and disinfecting at the same time as that of the pipeline. Care shall be taken to expel all air from the pipeline and services during any filling operation.
- B. Temporary Piping and Appurtenances for Flushing, Testing, and Disinfecting
 - 1. The Contractor and/or subcontractor shall supply all temporary piping, corporation and curb stops, test plates, bulkheads, plugs, pipe end caps, valves, fittings, calibrated meters, equipment, labor and method necessary for pressure testing, chlorinating, and flushing of the newly laid pipeline. The Contractor shall also provide any temporary piping, backflow devices, and appurtenances needed to carry potable water to the section of pipeline being flushed, pressure tested, or disinfecting.
 - 2. Corporation and curb stop taps used for flushing, pressure testing, and disinfecting shall comply with service tap requirements for ductile iron pipe. Unless specified otherwise, the tap shall be made at the top of pipe.
- C. Private fire service mains and lead-in connections to system risers shall be flushed thoroughly before connection is made to building system piping in order to remove foreign materials that might have entered the main during the course of the installation or that might have been present in existing piping. The minimum rate of flow shall be not less than the water demand rate of the system, which is determined by the system design, or not less than that necessary to provide a velocity of 10 ft/s, whichever is greater. For all systems, the flushing operations shall be continued for a sufficient time to ensure thorough cleaning. The General Contractor & Owner's Inspector shall be present during the flushing.
- D. It is the responsibility of the Contractor to dispose of the flushed water from the project area. The Contractor shall take all precautions necessary in providing for adequate drainage from the site. The disposal of water is described later in this Section.

3.08 HYDROSTATIC (PRESSURE) TESTING FOR DOMESTIC WATER SYSTEM

- A. The Contractor shall conduct the required hydrostatic testing of newly laid pipelines. After completion of the hydrostatic testing, the subcontractor shall provide a signed copy of all test results to the Inspector. The Contractor and Inspector shall be present during the testing.
- B. Test PVC plastic water system in accordance with UBPPA UNI-B-3 for pressure and leakage. The amount of leakage from PVC piping shall not exceed the amounts given in UBPPA UNI-B-3, except that no leakage is permitted for joints installed with sleeve type mechanical couplings.
- C. Test water service lines in accordance with applicable requirements of AWWA C 600. No leakage is permitted
- D. Pressure testing: Before pressure test, fill portion of piping being tested with water for a minimum of 24 hours. Provide hydrostatic pressure of 50 psi greater than the maximum working pressure of tested system. Provide and maintain hydrostatic test pressure for at least 2 hours to ensure no leakage of any portion of piping or appurtenances under pressure test.
- E. Repetition of Hydrostatic Test: If the leakage in the section of pipeline being tested exceeds the maximum allowable rate specified above, such section will be considered defective. The Contractor shall determine the points of leakage and make the necessary repairs at his expense. The subcontractor will then conduct another hydrostatic test. This procedure shall be continued until the leakage falls below the allowed maximum.
- F. After Satisfactory Hydrostatic Test:
 - 1. All valves shall be tested for leak proof tightness after the pipeline hydrostatic test with the test pressure on one side of the valve and atmospheric pressure on the other side.
 - 2. After test sections have successfully met the hydrostatic test requirements to the satisfaction of the Inspector, the entire pipeline or each test section shall be filled or shall remain filled with potable water until the pipeline is disinfected. Test plates, corporation stops, and other test facilities shall remain in place if needed for disinfecting or removed as directed by Inspector.
 - 3. Regardless of the hydrostatic test results, the Contractor shall repair all detectable leaks.

3.09 DISINFECTION PROCEDURES

- A. All potable water lines MUST be disinfected per the following requirements.
- B. The Contractor shall supply all materials, labor, equipment and methods necessary to disinfect the water main. The Contractor shall hire a State certified laboratory to perform the required bacteriological tests for the newly laid pipelines.

- C. Preparation for Disinfecting Pipelines: Contractor shall tightly shut off every service connection served by the pipeline being disinfected at the curb stop before water is applied to the pipeline. Care should be taken to expel all air from the main and services during the filling operation.
- D. Inject solution of liquid chlorine or sodium hypochlorite and water containing at least 50 PPM of free chlorine into a system in a manner to ensure that entire system is completely filled with solution. During this procedure operate valves and test outlets for residual chlorine. Continue injection until outlets indicate at least 59 PPM of free chlorine.
- E. After injection, isolate system and hold solution in retention for a period of at least 8 hours. Perform tests for residual chlorine after retention. If such tests indicate less than 50 PPM of residual chlorine, repeat entire procedure. After satisfactory sterilization has been verified, flush entire system until all traces of chlorine have been removed or until chlorine content is no greater than in existing water supply.

3.10 DISPOSAL OF TEST WATER

- A. The disposal of all water used in flushing, hydrostatic testing, and disinfecting the sections of pipeline shall be the sole responsibility of the Contractor. The disposal of water shall, in all cases, be carried out in strict observance of the water pollution control requirements of the California Regional Water Quality Control Board.
- B. The Contractor shall obtain an NPDES permit and comply with that permit in his discharge of test water.
- C. The Contractor shall apply a reducing agent to the solution to neutralize residual chlorine or chloramines remaining in the water. Additionally, the flow of water from the sections of pipeline shall be controlled to prevent erosion of surrounding soil, damage to vegetation, altering of ecological conditions in the area, and damage to any construction or maintenance activity occurring in any ditch or storm drain downstream of discharge.

3.11 CONNECTING TO EXISTING DISTRIBUTION SYSTEM

- A. After all hydrostatic tests and disinfecting has been completed and demonstrated to comply with the Specifications, the Contractor shall connect newly laid pipeline to the existing distribution system.
- B. Where connections are to be made to an existing potable water system, swab or spray the interior surfaces of all pipe and fittings used in making the connections with a five (5) percent or greater hypochlorite solution as directed by the Inspector.
- C. As soon as the connection is completed, thorough flushing is required until all discolored water is removed.

3.12 REMOVAL OF TEMPORARY PIPING AND APPURTENANCES

- A. After the newly laid section of pipeline has been approved by the Inspector for connection to the existing distribution system, the Contractor shall disconnect and

remove all temporary piping, fittings, test plates, backflow devices, and other appurtenances used for pressure testing, chlorinating, and flushing.

- B. Contractor shall remove and replace all stops used for testing and disinfecting of the pipeline with stainless steel repair clamps.

3.13 CLEANING

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

3.14 PROTECTION

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

END OF SECTION

SECTION 33 30 00
SANITARY UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Supply and installation of private sanitary sewer system as shown on Construction Documents.
- B. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all piping and including the demolition and removal of certain equipment, piping and appurtenances all as required and 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.

1.2 RELATED SECTIONS

- A. Trenching Requirements: Conform to the requirements of Section 31 20 00 – Earthwork.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer’s Catalog data for materials. Include technical data for pipe, gaskets, joints, couplings, and cleanout valve box with lid.
- B. Certificates:
 - 1. Submit manufacturer's certified statement that the pipe has been manufactured and tested in accordance with the applicable requirements of the California Plumbing Code, ASTM, & The Standard Specifications for Public Works Construction.

1.4 LICENSES, PERMITS & FEES

- A. The Contractor shall have a Class “C-34” or Engineering “A” Contractors license valid in the State of California.
- B. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for the construction of the work.
- C. The Owner shall reimburse the contractor for all necessary permits or inspection fees by any legally constituted agency.

1.5 DISPOSAL OF REMOVED MATERIALS INCLUDING ASBESTOS-CEMENT PIPE

- A. All removed materials, except those indicated on the plans or described herein to remain the property of the Owner, shall become the property of the Contractor and shall be disposed in accordance with local, state, and federal laws. Should any of those materials be considered as hazardous the Contractor shall provide the Owners Inspector with paper custody trail documentation of the disposal.
- B. Asbestos – Cement (A-C) Pipe Removal and Disposal: The plans for the project may indicate that existing asbestos-cement pipe is to be removed from the ground. Where so indicated the Contractor shall excavate with care, expose the pipeline and remove the A-C pipe to the nearest joint. Should the plans not call out the removal of the A-C pipe and A-C pipe is encountered, the Contractor shall obtain approval from the Inspector as to whether or not the A-C pipe is to be removed or can be left in place. Cutting of the pipe shall only be done if absolutely there is no other way to expose the length of pipe to the nearest joint that be separated and the Inspector approves the cutting of the pipe. Cutting of the pipe shall be done with a mechanical saw with a pressure water source to dampen the pipe and the dust from the cutting. To remove a coupling, the coupling may have to be broken in the trench. The pipe once removed from the trench may be broken for handling. The breaking shall be done within a plastic bagging or sheeting material to minimize the release of asbestos fibers into the atmosphere. Once removed and broken, if necessary, the A-C material shall be bagged and disposed of legally with the Inspector to be given a copy of all Contractor paperwork as to the legal disposal of the material. If the A-C pipe section(s) are removed intact the pipe can be removed by the Contractor from the project site and become the property and responsibility of the Contractor.

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, 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 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 acceptance. Only when Architect's acceptance is given, in writing, shall Contractor proceed with installation of the work.
- C. In case of a difference in the specifications or drawings, or between the specifications and the drawings or in the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

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.

1.10 SUBSTITUTIONS

- A. The Contractor assumes full responsibility that alternate manufacturers, 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 which 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 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.
- B. This Contractor is responsible 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.

- C. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials and decisions of the Architect or that of his representative shall be final and conclusive.

1.11 RECORD DRAWINGS

- A. Contractor shall provide and keep up-to-date a complete "as-built" record set of redline 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.

1.12 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 1. System Description: Grades and elevations are to be established with reference to the benchmarks referenced on the Plans.
 2. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction ("Green Book"), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the "Standard Specifications".
 3. California Plumbing Code, CPC, 2016 Edition, Chapter 7.
 4. California Administrative Code, Title 22, Section 64630(e)(2).
 5. Underwriters Laboratories.
 6. American Society of Testing Materials.

1.13 INSPECTION

- A. Notice shall be given to the Owner's Inspector at least 48 hours before starting construction.
- B. Contractor shall not allow or cause any of his work to be covered up before it has been duly inspected, tested and approved by the Owner, Architect or any other authorized inspectors having legal jurisdiction over his work. Should he fail to observe the above, he shall uncover the work and, after it has been inspected, tested and approved, recover it at his own expense.
- C. Inspection of the work shall not relieve the contractor of any obligations to complete the work as prescribed by the standard specifications. Any known defective work shall be corrected before testing or final inspection will be permitted. Unsuitable materials may be rejected even if these materials have been previously overlooked by the Inspector.
- D. The Owner shall have the authority to suspend the work completely or in part for such time as it may deem necessary if the contractor fails to carry out instructions given by the Owner, or to perform any required provisions of the plans and specifications. The contractor shall

immediately comply with a written order of the Owner to suspend the work completely or in part. The work shall be resumed when improper methods or defective work are corrected as ordered and approved in writing by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipeline:

1. Project site sanitary sewer.

- a. PVC Sewer Pipe, ASTM D-3034, SDR-35. The pipe will have a permanently installed reinforced rubber ring gasket in an integral bell joint. PVC Sewer Fittings SDR-35 shall be manufactured in accordance with ASTM Standards D-3034 and F-1336 or F-679. The PVC material shall have a minimum cell classification of 12454-B, 12454-C or 12364-C as defined in ASTM D-1784. Manufactured by J-M, Certainteed, Vinyl Tech, Diamond Plastics Corp, Pacific Western Plastics or approved equal.
- b. Acrylonitrile-Butadiene-Styrene Schedule 40 plastic drainpipe and fittings meeting the requirements of ASTM D 2661 and D 3311. Provide ABS solvent cement for piping and joint connections and install in accordance with IAMPO Standards IS 5, 9, and UPC Section 718.
- c. Vitrified Clay Pipe (VCP): VCP and fitting shall conform to ASTM C700, Extra Strength

B. Cleanout Assemblies: Cleanout plug shall be line size.

1. See Construction Documents for details.

C. Concrete, Mortar and Related Materials: Conform to Section 32 13 13 – Cement Concrete Paving.

D. Manhole Brick Mortar, Grout, and Plaster: Conform to Standard Specifications for Public Works Construction, Section 202 - Masonry Materials.

E. Metal Covers, Frames and Accessories:

1. Conform to Section 206 – Miscellaneous Metal Items of the Standard Specifications for Public Works Construction.
2. Metal Covers and Frames: Vandal-resistant design.
3. Hot-dip galvanize all steel parts after fabrication and prior to assembly in accordance with Section 210 – Paint and Protective Coating of the Standard Specifications for Public Works Construction.

F. Bedding Materials: Conform to the requirements of Section 31 20 00 – Earthwork.

PART 3 - EXECUTION ON PRIVATE PROPERTY

3.1 PIPELINE INSTALLATION

- A. Install pipeline in a practical alignment and uniform slope to the point of connection as indicated on the plans. Prior to trench excavation, verify size, material, depth, and location of the point of connection. Notify Civil Engineer if point of connection elevation is different than that shown on construction drawings as it may affect the design of the system.
- B. No pipe shall be laid until the Geotechnical Project Manager inspects and approves the conditions of the bottom of the trench.
- C. Pipe laying shall proceed "up grade" with the spigot section of the bell-and-spigot pipe pointing in the direction of the flow.
- D. Each section of pipe shall be laid true to line and grade and in such a manner as to form an close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line.
- E. Where invert elevations are indicated, run pipe at a uniform slope between inverts shown.
- F. Join pipes and fittings as recommended by the manufacturer.
- G. All sewer lines & cleanouts shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the Inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.
- H. Refer to ASTM D 2321-00 "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications" or Uni-Bell PVC Pipe Association UNI-PUB-6 "Installation Guide for PVC Solid-Wall Sewer Pipe" for installation information.
- I. Pipe shall not be laid when the condition of the trench or the weather is unsuitable.
- J. The interior of the sewer pipe shall be kept clean of dirt and debris at all times. When work is not in progress, open ends of pipe and fittings shall be plugged.
- K. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and bulled forward past every joint immediately after joining has been completed.

3.2 CLEARANCES OF SANITARY PIPELINE

- A. Buildings or Structures - 2 feet.
- B. Parallel to Water Line:
 - 1. Building sanitary drain, (that which starts from the building perimeter to existing site sewer) shall not be laid in a common trench with the water line unless the bottom of the water line shall be at least 12 inch above the top of the sewer pipeline.

2. In addition, the water pipe shall be placed on a solid shelf excavated on one side of the common trench with a minimum clear horizontal distance of 12 inch sewer or drain line.
3. Site sanitary sewer (receiving more than one building sanitary drain or acid pipeline) shall be separated from the water line in accordance with the requirements of the State of California, Human and Welfare Agency, Department of Health Services.

C. Crossing Water Line:

1. Building sanitary drain shall be installed a minimum of 12 inches below the potable water line
2. Site sanitary sewer shall be separated from the water main in accordance with the requirements of the State of California Administrative Code, Title 22, Section 64630(e)(2).

3.3 CLEANOUTS

- A. In general, provide cleanouts at the upper terminal for each sanitary pipeline, at intervals not exceeding 100 feet in straight run and any fraction thereof and for each aggregate horizontal change in direction exceeding 135 degrees. See construction drawings for locations.
- B. Install required cleanouts before horizontal pipelines are covered.
- C. In concrete-paved areas, extend cleanouts flush with finish grade.
- D. In unpaved and asphalt-paved areas, install cleanouts in yard boxes 4 inches below the yard box cover.
- E. In traffic areas, install countersunk cleanout plugs where raised heads protrude.

3.4 PIPE REMOVAL

- A. Contractor shall leave the existing campus sewer lines in place during construction except at service laterals to buildings where they shall be removed and disposed.
- B. Sewer lines which are to remain as abandoned, but have had pipe cut and removed, shall be capped.

3.5 PROTECTION

- A. Where new building sewers are to be connected into a sewer line which is in active use, the CONTRACTOR shall call for such protection as is necessary to prevent construction debris from being washed into the active sewers. Plugged inlets or other suitable protection shall be called for in the active manhole before beginning manhole modifications or tract sewer cleaning.

3.6 FIELD INSPECTION FOR PLASTIC PIPE & FITTINGS

- A. Inspect interior of sewer piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place with the use of closed

circuit television (cctv), and again at completion of Project. The final video inspection shall be performed after the successful completion of the air or water pressure test and mandrel test and prior to the certificate of occupancy by the Owner for the new building. All mains and sewer laterals shall be video inspected. The Contractor shall give the Inspector a minimum of 48 hours notice prior to this video inspection. A video tape of the inspected pipeline shall be delivered to the Inspector for approval.

1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Crushed, broken, cracked, or otherwise damaged piping.
 - c. Infiltration: Water leakage into piping.
 - d. Exfiltration: Water leakage from or around piping.
2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. Re-inspect and repeat procedure until results are satisfactory.

3.7 TESTING OF SEWER PIPE

- A. After installation of sewer pipe, testing shall be performed. The piping of the sewer system shall be tested with water or air except that plastic pipe shall not be tested with air. Contractor to follow guidelines set forth by the California Plumbing Code section 712.0 Testing.

3.8 CLEANUP

- A. The pipe installation shall be thoroughly cleaned after all testing has occurred. Cleaning shall be performed by the Contractor by means of an inflatable rubber ball. The ball shall be of a size that will inflate to fit snugly into the pipe to be tested. The ball shall be controlled with a tag line. The ball shall be placed in the last maintenance hole on the pipe to be cleaned, and water shall be introduced behind it. The ball shall pass through the pipe with only the pressure of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first maintenance hole where its presence is noted. In the event cement or wedged debris or a damaged pipe shall stop the ball, the Contractor shall remove the obstruction.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Contractor shall furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all piping and including the demolition and removal of certain equipment, piping and appurtenances all as required and 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.
- B. Supply and installation of private storm drain system from building wall perimeter, unless otherwise noted, to a point within the owner's property as shown on the construction documents.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's catalog data for all required materials. Include technical data for pipe, drain inlets, catch basins, grates, information concerning gaskets, joints and couplings.
- B. Contractor is responsible for providing shoring plans to the Inspector for approval prior to construction. Excavation shall have sheeting, shoring and bracing conforming to CAL/OSHA requirements. Lateral pressures for design of sheeting, shoring and bracing shall be based on type of soil exposed, groundwater conditions, surcharge loads adjacent to the excavation and type of shoring that will be used.

1.3 RELATED SECTIONS

- A. Trenching Requirements: Conform to the requirements of Section 31 20 00 – Earthwork.

1.4 LICENSES, PERMITS & FEES

- A. The Contractor shall have a Class "C-34", "C-36", "C-42" or Engineering "A" Contractors license valid in the State of California.
- B. The Contractor shall obtain all necessary permits, licenses, or agreements required by any legally constituted agency, pay for all fees and give all necessary notices required for the construction of the work.
- C. The Owner shall reimburse the contractor for all necessary permits or inspection fees by any legally constituted agency.

1.5 QUALITY ASSURANCE

- A. The work provided herein shall conform to and be in accordance with the Contract Plans, General Conditions/Specifications and Special Provisions, as well as the Standard Specifications for Public Works Construction (“Green Book”), 2015 Edition, adopted by the Southern California Chapter, American Public Works Association; herein referred to as the “Standard Specifications”.

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 SEQUENCING AND SCHEDULING

- A. Coordinate with other utility work.

1.8 DISPOSAL OF REMOVED MATERIALS

- A. All removed materials, except those indicated on the plans or described herein to remain the property of the Owner, shall become the property of the Contractor and shall be disposed in accordance with local, state, and federal laws. Should any of those materials be considered as hazardous the Contractor shall provide the Owners Inspector with paper custody trail documentation of the disposal.

1.9 SUBSTITUTIONS

- A. The Contractor assumes full responsibility that alternate manufacturers, 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 which 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 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.
- B. This Contractor is responsible 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.
- C. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials and decisions of the Architect or that of his representative shall be final and conclusive.

1.10 RECORD DRAWINGS

- A. Contractor shall provide and keep up-to-date a complete "as-built" record set of redline 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, pipe invert locations, drain basins, 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.

1.11 INSPECTION OF WORK

- A. Contractor shall not allow or cause any of his work to be covered up before it has been duly inspected, tested and approved by the Owner or any other authorized inspectors having legal jurisdiction over his work. Should he fail to observe the above, he shall uncover the work and, after it has been inspected, tested and approved, recover it at his own expense.
- B. Inspection of the work shall not relieve the contractor of any obligations to complete the work as prescribed by the standard specifications. Any known defective work shall be corrected before testing or final inspection will be permitted. Unsuitable materials may be rejected even if these materials have been previously overlooked by the Inspector.
- C. The Owner shall have the authority to suspend the work completely or in part for such time as it may deem necessary if the contractor fails to carry out instructions given by the Owner, or to perform any required provisions of the plans and specifications. The contractor shall immediately comply with a written order of the Owner to suspend the work completely or in part. The work shall be resumed when improper methods or defective work are corrected as ordered and approved in writing by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Solid Wall Piping Materials
 - 1. Poly Vinyl Chloride (PVC) Sewer Pipe, ASTM D-3034, SDR-35. The pipe will have a permanently installed reinforced rubber ring gasket in an integral bell joint. PVC Sewer Fittings SDR-35 shall be manufactured in accordance with ASTM Standards D-3034 and F-1336 or F-679. The PVC material shall have a minimum cell classification of 12454-B, 12454-C or 12364-C as defined in ASTM D-1784.
 - 2. Cast iron soil, hubless, with stainless steel-banded hubless couplings. No-hub cast iron soil pipe and fittings shall conform to ASTM A 888 and/or standard specifications 301 of the Cast Iron Soil Pipe Institute. No-hub joints shall conform to specification 310 of the Cast Iron Soil Pipe Institute and/or ASTM C 1277. Joints shall be installed according to manufacturer's recommendations. Manufactured by American Foundry, Tyler, or equal.

3. Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40, meeting ASTM D 1785 standards. Fittings shall conform to ASTM D 2467 "Socket-Type PVC Plastic Type Fittings, Schedule 40.
- B. Grates & Covers:
1. All grates and covers must be vandal proof / bolt down type.
 2. A.D.A. - Where noted on the plans install A.D.A. grates on catch basins. A maximum spacing between grating bars in accessible path of travel is 1/2 inch in the direction of travel, or 1/2 inch in either direction when the path of travel is not limited to one direction.
 3. Heel Proof - Where noted on the plans install heel proof grates on catch basins requiring a maximum ¼ inch opening.
- C. Steel Reinforcing Bars: ASTM A 615 deformed grade 40 billet steel, plain finish, unless otherwise specified on Construction Document.
- D. Concrete, Mortar and Related Materials: Conform to Section 32 13 13: Cement Concrete Pavement.
- E. Manhole Brick Mortar, Grout, and Plaster: Conform to Standard Specifications for Public Works Construction, Section 202 - Masonry Materials.
- F. Paint and Protective Coatings
1. All storm drain hardware, including frames and covers, grates, protection bars, steps, etc., shall be protected from corrosion. Storm drain hardware made of cast iron shall be protected by painting with, or dipping in, a commercial grade asphalt paint. Storm drain hardware made of steel shall be galvanized.
 2. Hot-dip galvanize steel parts after fabrication and before installation, in accordance with Section 210 - Paint and Protective Coating of the Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.1 PIPELINE INSTALLATION

- A. Existing utilities: Locate existing underground utilities in all areas of work prior to excavation or commencement of work. If utilities are to remain in place provide adequate means of protection during trenching operations.
- B. Install pipeline in a practical alignment and uniform slope to the point of connection as indicated on Construction Document. Prior to trench excavation, verify size, material, depth, and location of the point of connection. Notify Civil Engineer if point of connection elevation is different than that shown on construction drawing as it may affect the design of the system.
- C. Excavating, trenching, and backfilling are specified in Section 31 20 00 – Earthwork.

- D. No pipe shall be laid until the Geotechnical Project Manager inspects and approves the conditions of the bottom of the trench.
- E. All storm drain pipelines, trench drains, catch basins and drain inlets shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the Inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.
- F. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- G. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- H. Make connections to existing piping and underground structures so finished work complies as nearly as practical with requirements specified for new work.
- I. The cutting of pipe for inserting tees, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. No pipe shall be laid in water or when, in the option of the Engineer trench conditions are unsuitable.
- J. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting soil into it, the Engineer may require that before lowering the pipe into the trench, a temporary plug be placed over each end and left there until the connection is to be made to the adjacent pipe. During the laying operations, no debris, tools, clothing or other materials shall be left in the pipe.
- K. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug or other means approved by the Engineer. This provision shall apply during the lunch-hour breaks as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.
- L. All grates, frames and covers for drain inlets, catch basins & trench drains shall be locked down to prevent theft after final construction.

3.2 FIELD INSPECTION FOR PIPE & FITTINGS

- A. Television Inspection: The entire length of all new storm drain pipe 6" AND GREATER shall be inspected using Closed-Circuit Television (CCTV) equipment. The inspection shall be conducted after the line has been successfully installed, covered with bedding material, and prior to paving. The inspection shall be conducted in the presence of the Inspector. All labor and equipment necessary to conduct the CCTV inspection shall be furnished by the Contractor. CCTV inspection shall be per the following.
 - 1. Record the inspection using a four-head, VHS format, video cassette recorder in standard play mode. Deliver the original videotapes, audio commentary, log sheets, and

reports to the I.O.R. at the close of the each working day. As desired, the Contractor may produce duplicates for his own use. At the option of the Contractor, or request of the Owner, the video recordings may be converted to MPEG format and copied onto a DVD compatible with Microsoft software.

2. CCTV Equipment: Camera: Remote-controlled, focus from 6" to infinity. Resolution at 450 lines per inch, minimum. During the reinstatement of laterals, only use "rotating lens" or "pan and tilt" cameras. Footage counter: Accurate within $\pm 1\%$. Include the real time counter measurement as a caption on the recorded tape. Use maintenance hole stations and maintenance hole numbers as references. Television monitor: Color, minimum 460 lines per inch resolution. Lighting: Adequate to fully illuminate the pipeline and positioned to not produce glare. Mobility: Capable of steadily traveling with or against the flow. The maximum speed while inspecting and recording is 9 m per minute (30 feet per minute).
3. Quality of CCTV Inspection Record: The recorded video image must clearly show the full circumference of the pipeline, in focus, with adequate lighting to see detail, with uniform and steady travel, and depicting the date and time of inspection, footage of travel, street, project title and pipe size. At laterals, service connections and pipe defects, provide a closer, more detailed examination and document the orientation, location and size. The written records must further describe those laterals, service connections and pipe defects and index them to their location on the video record.
4. Introduce water into the upstream end of the pipe for the required length of time such that the water flow leaving the pipe at the downstream end equals the flow entering the upstream end of the pipe. Discontinue water flow and perform the CCTV inspection of the pipe.
5. If debris is encountered, retrieve the CCTV unit, re-clean the pipeline and resume CCTV inspection. Pipe will be considered acceptable when the video camera records no ponding of water (except in joint recesses) within the pipe, no breaks in the pipe and no openings or breaks at the joints, and the pipe is clean and free of dirt and debris. Remove and replace, or readjust to grade, any pipe failing to meet the acceptable video requirements.
6. At the completion of the video inspection, one copy of the tapes shall be turned over to the I.O.R.
7. Defects requiring correction include the following:
 - 1) Alignment: Less than full diameter of inside of pipe is visible between structures.
 - 2) Crushed, broken, cracked, or otherwise damaged piping.
 - 3) Exfiltration: Water leakage from or around piping.
 - 4) Infiltration: Water leakage into piping.
 - b. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - c. Re-inspect and repeat procedure until results are satisfactory.

B. CLEANUP

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

END OF SECTION