

# Project Manual

## BUILDING 700 HVAC REPLACEMENT

### IMPERIAL VALLEY COLLEGE IMPERIAL, CA

## Construction Documents



ARCHITECTS

707 Brookside Avenue  
Redlands, CA 92373  
909- 375-3030

JUNE 2020  
SGH Project No. 19-43103-00



**SECTION 00 01 01  
PROJECT TITLE PAGE**

**FOR**

**BUILDING 700 HVAC REPLACEMENT**

**PROJECT NUMBER: 19-43103-00**

**IMPERIAL COMMUNITY COLLEGE DISTRICT  
380 E. ATEN RD., IMPERIAL, CA 92251  
760-352-8320  
WWW.IMPERIAL.EDU**

**PROJECT LOCATION**

**380 E. ATEN RD., IMPERIAL, CA 92251**

**PREPARED BY:**

**SGH ARCHITECTS**

707 Brookside Avenue, Redlands, California 92373  
909.375.3030  
[www.sgharch.com](http://www.sgharch.com)



**SECTION 00 01 02**  
**PROJECT INFORMATION**

**PART 1 GENERAL**

**1.01 PROJECT IDENTIFICATION**

- A. Project Name: Building 700 HVAC Replacement  
Project Number: 19-43103-00  
Imperial Valley College  
380 E. Aten Rd.  
Imperial, CA 92251
- B. The Owner, hereinafter referred to as District: Imperial Valley College District  
**Imperial Valley College District**  
380 E. Aten Rd., Imperial, CA 92251  
www.imperial.edu  
760.352.8320

**1.02 NOTICE TO PROSPECTIVE BIDDERS**

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

**1.03 PROJECT DESCRIPTION**

- A. Summary Project Description: Removal & replacement of existing HVAC equipment; Removal of existing hydronic piping for HVAC equipment to be removed; Installation of refrigeration lines for new HVAC equipment; Modifications to the electrical system to support the HVAC upgrades; Construction of CMU enclosure for new ground level HVAC equipment; and Patch and repair of paving for new electrical trench.
- B. Contract Scope: Construction, demolition, and renovation.
- C. Contract Terms: Lump sum (fixed price, stipulated sum), with incentives.

**1.04 PROJECT CONSULTANTS**

- A. The Architect, hereinafter referred to as Architect: **SGH Architects**  
707 Brookside Avenue, Redlands, California 92373  
www.sgharch.com  
909.375.3030

**1.05 PROCUREMENT TIMETABLE**

- A. Last Request for Substitution Due: 7 days prior to due date of bids.
- B. Last Request for Information Due: 7 days prior to due date of bids.
- C. Bid Opening: Same day, 3 PM local time.

- D. Bids May Not Be Withdrawn Until: 30 days after due date.
- E. Contract Time: To be stated in bid documents.
- F. The District reserves the right to change the schedule or terminate the entire procurement process at any time.

**1.06 PROCUREMENT DOCUMENTS**

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

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION**

SECTION 00 01 07  
SEALS PAGE

IDENTIFICATION STAMP  
DIV. OF THE STATE ARCHITECT

APP: 04-119344 INC:  
REVIEWED FOR

SS  FLS  ACS

DATE: 07/28/2020

**ARCHITECT**

Michael J. Stephens, AIA  
SGH Architects, Inc.  
707 Brookside Avenue  
Redlands, California 92373  
(909) 375-3030  
[mstephens@sgharch.com](mailto:mstephens@sgharch.com)



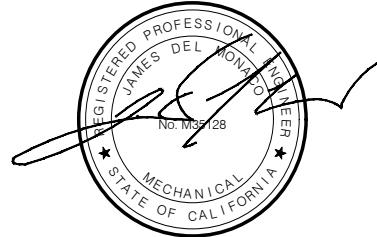
**STRUCTURAL**

Les Tso, Principal  
Hohbach-Lewin, Inc.  
511 Mission Blvd.  
Pasadena, CA 91030  
(626)441-1211 x500  
[ltso@hohbach-lewin.com](mailto:ltso@hohbach-lewin.com)



**MECHANICAL and PLUMBING**

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**ELECTRICAL**

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[marco.cabibbo@p2sinc.com](mailto:marco.cabibbo@p2sinc.com)







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**SECTION 00 40 25  
REQUEST FOR INFORMATION**

**RFI NUMBER:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**PROJECT NAME: BUILDING 700 HVAC REPLACEMENT – IMPERIAL VALLEY COLLEGE**

**PROJECT NO.: 19-43103-00**

**TO: SGH ARCHITECTS**

707 Brookside Avenue, Redlands, California 92373

Attention: \_\_\_\_\_

Contractor: \_\_\_\_\_

Address: \_\_\_\_\_

Request By: \_\_\_\_\_ Date: \_\_\_\_\_

**BRIEF SUMMARY OF RFI:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Drawing No. \_\_\_\_\_ Detail No. \_\_\_\_\_

Specification Section \_\_\_\_\_ Title \_\_\_\_\_

Page \_\_\_\_\_ Paragraph \_\_\_\_\_

**DETAILS OF THIS RFI:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Attachments: \_\_\_\_\_

\_\_\_\_\_

RESPONSE WILL BE INCLUDED IN AN ADDENDUM

**END OF RFI**

**SECTION 00 43 25**  
**SUBSTITUTION REQUEST FORM - DURING PROCUREMENT**

**SUBSTITUTION REQUEST NO.** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**PROJECT NAME:**        **BUILDING 700 HVAC REPLACEMENT**

**PROJECT NUMBER:**   **19-43103-00**

**TO:**                        **SGH ARCHITECTS**

707 Brookside Avenue, Redlands, California 92373

From: \_\_\_\_\_

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

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

**SPECIFIED PRODUCT:** \_\_\_\_\_

Project Manual Section Title \_\_\_\_\_ Number \_\_\_ Page \_\_\_\_ Paragraph \_\_\_\_.

Drawing No. \_\_\_\_\_ Detail No. \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Tel: \_\_\_\_\_

- A. Is the point-by-point comparative data attached? — REQUIRED BY A/E
- B. Reason request for substitution is being submitted: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED PRODUCT**

- A. Does proposed substitution affect in any way the Structural Safety, Access Compliance, or Fire & Life Safety portions of the project?    No\_\_ Yes\_\_  
Explain \_\_\_\_\_  
\_\_\_\_\_
- B. Does proposed substitution affect dimensions, gages, weights, etc. on Drawing? No\_\_ Yes\_\_  
Explain \_\_\_\_\_  
\_\_\_\_\_

- C. Does proposed substitution require changes in Drawings or design and installation changes?  
No \_\_\_ Yes \_\_\_ \_\_\_\_\_  
(If yes, cost of these changes is the responsibility of the Contractor.)
- D. Does proposed substitution affect product cost, delivery time, or construction schedule?  
No \_\_\_ Yes \_\_\_ Explain \_\_\_\_\_
- E. Does proposed substitution comply with specified ICC Number, UL Rating, ASTM Numbers?  
No \_\_\_ Yes \_\_\_ Explain \_\_\_\_\_
- F. Does proposed substitution affect other trades and systems such as wiring, piping, ductwork, structure, etc.? No \_\_\_ Yes \_\_\_ (Explain which and how) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- G. Does proposed substitution product guarantee differ from that of the specified product?  
No \_\_\_ Yes \_\_\_ Explain \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

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

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

Submitted by: \_\_\_\_\_  
(Type Name)
Signature
Date

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

**END OF SECTION**



**SECTION 00 63 25**  
**SUBSTITUTION REQUEST FORM (POST-AWARD)**

**SUBSTITUTION REQUEST NO.** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**PROJECT NAME:** **BUILDING 700 HVAC REPLACEMENT – IMPERIAL VALLEY COLLEGE**

**PROJECT NUMBER:** **19-43103-00**

**TO:** **SGH ARCHITECTS**

707 Brookside Avenue, Redlands, California 92373

From: \_\_\_\_\_

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

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

Specified Product: \_\_\_\_\_

Project Manual Section Title \_\_\_\_\_ Number \_\_\_ Page \_\_\_\_ Paragraph \_\_\_\_.

Drawing No. \_\_\_\_\_ Detail No. \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Tel: \_\_\_\_\_

A. Reason request for substitution is being submitted: \_\_\_\_\_

\_\_\_\_\_

B. Does proposed substitution affect in any way the Structural Safety, Access Compliance, or Fire & Life Safety portions of the project? No\_\_ Yes\_\_

Explain \_\_\_\_\_

\_\_\_\_\_

C. Does proposed substitution affect dimensions, gages, weights, etc. on Drawing? No\_\_ Yes\_\_

Explain \_\_\_\_\_

\_\_\_\_\_

D. Does proposed substitution require changes in Drawings or design and installation changes? No\_\_ Yes\_\_

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

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

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

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

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

No cost impact \_\_\_\_ Improve Schedule \_\_\_\_ Credit of \$\_\_\_\_\_

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

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

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

Submitted by: \_\_\_\_\_  
 (Type Name) Signature Date

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

Architect's Comments:

\_\_\_\_ Accepted, \_\_\_\_ accepted as noted, \_\_\_\_ not accepted, \_\_\_\_ received too late.

Reviewed by:

\_\_\_\_\_  
 Architect Date

\_\_\_\_\_  
 Construction Manager Date

\_\_\_\_\_  
 District Date

**END OF SECTION**

**SECTION 01 10 00**  
**SUMMARY**

**PART 1 GENERAL**

**1.01 PROJECT**

- A. Project Name: Building 700 HVAC Replacement
- B. District's Name: Imperial Valley College
- C. Architect's Name: SGH Architects.
- D. The Project consists of: Complete replacement of the mechanical (HVAC) equipment. Modifications to the electrical system to support the HVAC upgrades and necessary fire alarm upgrades.

**1.02 CONTRACT DESCRIPTION**

- A. Contract Type: Multiple prime contracts each based on a Stipulated Price as described in Owner-Contractor Agreement.
- B. The work of each separate prime contract is identified in this section and on Drawings.
- C. The Work: The Work is construction and related services for a , CBC, Occupancy Type Business Group B and Assembly Group A2, Construction Type III-A, totaling approximately 43,345 square feet.
  - 1. The work includes HVAC replacement, and related site improvements; with patch and repair as required, and other features to the extent indicated on the Drawings.

**1.03 CONTRACT DOCUMENTS**

- A. Contract Requirements:
  - 1. Conditions of the Contract and other Contract documents have been included in the Project Manual, as indicated in the Table of Contents.
    - a. Such documents are not Specifications.
  - 2. Specifications are found in Divisions 1 through 32 of the Project Manual.
- B. Contract Drawings: The Drawings provided with and identified in the Project Manual are the Drawings referenced in the Agreement.
  - 1. The location, extent and configuration of the required construction and improvements are shown and noted on Drawings.
    - a. The Drawings are referenced in the Agreement.
    - b. An index of Drawings is included in the set of Drawings.
  - 2. Drawings are arranged into series according to design discipline. Such organization and all references to trades, subcontractor, specialty contractor or supplier shall not control the Contractor in dividing the Work among subcontractors or in establishing the extent of the Work to be performed by any trade.

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

#### **1.04 DESCRIPTION OF ALTERATIONS WORK**

- A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 41 00.
1. The intent of these drawings and specifications are the work of HVAC Replacement and shall be submitted and approved by DSA before proceeding with the repair work. CAC Section 4-317.
- B. Scope of alterations work is indicated on drawings:
- Removal and replacement of existing HVAC equipment.
  - Removal of existing hydronic piping for HVAC equipment to be removed.
  - Installation of refrigeration lines for new HVAC equipment.
  - Removal of existing hydronic piping for HVAC equipment to be removed.
  - Installation of refrigeration lines for new HVAC equipment.
  - Modifications to the electrical system to support the HVAC upgrades.
  - Construction of CMU enclosure for new ground level HVAC equipment.
  - Patch and repair of paving for new electrical trench.

#### **1.05 PERMITS, LICENSES AND FEES**

- A. Permits:
1. For Work included in the Contract, Contractor shall obtain all permits from authorities having jurisdiction and from serving utility companies and agencies.
  2. District will reimburse Contractor for amount charged for such permits, without mark-up.
  3. For Work performed under design/build basis, plancheck and permit fees shall be included in the Contract Sum.
- B. Licenses:

1. Contractor shall obtain and pay all licenses associated with construction activities, such as business licenses, contractors' licenses and vehicle and equipment licenses.
  2. All costs for licenses shall be included in the Contract Sum.
- C. Assessments:
1. District will pay all assessments and utility service connection fees. Costs of assessments shall not be included in the Contract Sum.
- D. Test and Inspection Fees:
1. Contractor shall pay all fees charged by authorities having jurisdiction and from serving utility companies and agencies, for tests and inspections conducted by those authorities, companies and agencies.
  2. District will reimburse Contractor for actual amount of such fees, without mark-up.
  3. Refer to Section 01 40 00 - Quality Requirements for additional information on tests and inspections and responsibility for payment of fees.

#### **1.06 OWNER OCCUPANCY**

- A. District intends to continue to occupy adjacent portions of the existing site during the entire construction period.
- B. District intends to occupy the Project upon Substantial Completion.
- C. District intends to occupy a certain portion of the Project prior to the completion date for the conduct of normal operations.
- D. Cooperate with District to minimize conflict and to facilitate District's operations.
- E. Schedule the Work to accommodate District occupancy.

#### **1.07 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
  1. District occupancy.
  2. Work by Others.
  3. Work by District.
  4. Use of site and premises by the public.
- C. Provide access to and from site as required by law and by District:
  1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  2. Site Access:
    - a. Limit access to site to indicated routes and access points as indicated.
    - b. If routes and access points are not indicated, access shall be as approved by District.
    - c. Do not restrict access to adjacent properties and do not restrict access for those performing work under separate contracts for the District.
  3. Do not obstruct roadways, sidewalks, or other public ways without permit.

4. Construction Limit:
  - a. Limit construction activities to areas indicated on Drawings as Project Area or, if not indicated, to areas within the parcel as described in the legal description on the Drawings.
  - b. Refer also to Section 01 50 00 - Temporary Construction Facilities and Controls for additional requirements.
- D. Existing building spaces may not be used for storage.
- E. Time Restrictions:
  1. Limit conduct of especially noisy, malodorous, and dusty exterior work to the hours of 7 AM to 6 PM.
- F. Utility Outages and Shutdown:
  1. Limit disruption of utility services to hours the site is unoccupied.
  2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to District and authorities having jurisdiction.
  3. Prevent accidental disruption of utility services to other facilities.

#### **1.08 CONSTRUCTION WASTE MANAGEMENT**

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

#### **1.09 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS**

- A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.
- B. Section 01 20 00 - Price and Payment Procedures.
- C. Section 01 30 00 - Administrative Requirements.
- D. Section 01 31 14 - Facility Services Coordination.
- E. Section 01 32 16 - Construction Progress Schedule.
- F. Section 01 35 53 - Security Procedures.
- G. Section 01 40 00 - Quality Requirements.
- H. Section 01 42 19 - Reference Standards.
- I. Section 01 50 00 - Temporary Facilities and Controls.
- J. Section 01 51 00 - Temporary Utilities.
- K. Section 01 52 13 - Field Offices and Sheds.
- L. Section 01 55 00 - Vehicular Access and Parking.
- M. Section 01 58 13 - Temporary Project Signage.
- N. Section 01 60 00 - Product Requirements.
- O. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

- P. Section 01 70 00 - Execution and Closeout Requirements.
- Q. Section 01 78 00 - Closeout Submittals.

**END OF SECTION**





**SECTION 01 20 00**  
**PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 SCHEDULE OF VALUES**

- A. Use Schedule of Values Form:
  - 1. Form provided by District.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- H. Revise schedule to list approved Change Orders, with each Application For Payment.
  - 1. List each authorized Change Order as an extension on the continuation sheet, listing the Change Order number and dollar value as for an original portion of Work.

**1.04 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
  - 1. Substantiating information will normally be required only for those portions of Work whose completion state cannot be readily determined by observation of the completed Work.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Balance to Finish.
  - 9. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
  - 1. No Change Orders shall be included with Application for Payment until approved in writing by District and Architect. Also approved by DSA when appropriate.
- I. Submit one electronic and three hard-copies of each Application for Payment.
- J. Include the following with the application:
  - 1. Transmittal letter as specified for submittals in Section 01 33 00.
  - 2. Construction progress schedule, revised and current as specified in Section 01 33 00.
  - 3. Current construction photographs specified in Section 01 33 00.
  - 4. Partial release of liens from major subcontractors and vendors.
    - a. Provide with each Application for Payment lien releases from all subcontractors, workers and materials suppliers employed for the Project covering their portion of Work to date for which payment application is made. Lien release forms will be provided by District and shall be completed in accordance with directions provided.
  - 5. Project record documents as specified in Section 01 78 00, for review by District which will be returned to the Contractor.
  - 6. Affidavits attesting to off-site stored products.
- K. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

### **1.05 ADDENDA**

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

### **1.06 MODIFICATION PROCEDURES**

- A. Construction Changes, General:
  - 1. The following describe administrative procedures to be followed in compliance with provisions of the Conditions of the Contract for Architect's Supplemental Instructions, Construction Change Directives, Construction Change Documents, and Contract Change Orders.
  - 2. The Architect will prepare and issue a Bulletin on which the Architect's Supplemental Instructions, a Construction Change Directive or a Request for Proposal will be presented to the Contractor for action.
- B. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to Contract Documents.
- C. Contract Change Order Forms: Form as directed by District.
- D. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
  - 1. Architect's Supplemental Instructions:
    - a. Minor changes in the Work, not involving an adjustment in either the Contract Sum or Contract Time, as authorized by the Conditions of the Contract, will be presented by the Architect using the Architect's Bulletin form.
    - b. Should the Architect's Supplemental Instructions result in disputed costs and time adjustments, such dispute shall be resolved in accordance with the provisions of the Conditions of the Contract.
- E. For other required changes, not involving structural, accessibility, or fire-life-safety portions of approved Drawings and Specifications, Architect will issue a document signed by District instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
  - 2. Promptly execute the change.

3. DSA Construction Change Document approval for substitutions and changes to structural, accessibility, or fire-life-safety portions of approved Drawings and Specifications is required from DSA prior to fabrication and installation. CAC Section 4-215, 4-233(c), & 4-338(c).
  - a. The approved Construction Change Document shall be signed by:
    - 1) Architect of Record.
    - 2) When applicable:
      - (a) Structural Engineer of Record.
      - (b) Mechanical Engineer of Record.
      - (c) Electrical Engineer of Record.
      - (d) Delegated Professional Engineer.
    - 3) Division of the State Architect for final approval.
4. Construction Change Directives: In accordance with provisions of the Conditions of the Contract, the District may direct the Contractor to proceed with a change in the Work prior to formal preparation, review and agreement of a Contract Change Order, in order to not delay construction.
  - a. The Architect will prepare and issue a change document containing a Construction Change Directive which, when signed by the District and the Architect, shall instruct the Contractor to proceed with a change in the Work, for subsequent inclusion in a Contract Change Order.
  - b. Should the Construction Change Directive result in disputed costs and time adjustments, such dispute shall be resolved in accordance with the provisions of the Conditions of the Contract.
  - c. Construction Change Directives shall follow procedures specified below for Contract Change Orders except that Contractor shall immediately proceed with the change upon receipt of the signed Change Directive.
- F. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days.
  1. Such Request for Proposal may include an estimate of additions or deductions in Contract Time and Contract Sum for executing the change and may include stipulations regarding overtime work and the period of time the requested response from the Contractor shall be considered valid.
- G. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00.
  1. After review of the request and with the District's approval, the Architect will prepare a change document containing a Request for Proposal, as described above.
  2. Issuance of such a request by the Architect shall not indicate authorization of the Contractor to proceed with the proposed change.

3. Changes will be approved only by an approved Construction Change Directive and Contract Change Order.
- H. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
  2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
  3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
  4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- I. Substantiation of Costs: Provide full information required for evaluation.
1. On request, provide the following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
    - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
  3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
    - a. Cost and Time Resolution: If amounts for changes in Contract Sum and Contract Time cannot be agreed upon by District and Contractor, amounts shall be resolved in accordance with provisions of the Conditions of the Contract for resolution of disputes and the following:
      - 1) Contractor shall keep accurate records of time, both labor and calendar days, and cost of materials and equipment.
      - 2) Contractor shall prepare and submit an itemized account and supporting data after completion of changed Work, within the time limits indicated in the Conditions of the Contract.
      - 3) Contractor shall provide full information as required and requested, for District and Architect to evaluate and substantiate proposed costs and time for the change in the Work.

- 4) When District and Contractor determine mutually acceptable amounts for changes in Contract Sum and Contract Time, a Contract Change Order shall be executed for these amounts.
  - 5) District shall have the right to audit Contractor's invoices and bid quotations to substantiate costs for Contract Change Orders.
- J. Construction Changes Based on Stipulated Sum or Time: Based on the Contractor's response to a Request for Proposal or Construction Change Directive, the District and Architect will review the response.
1. The District and Contractor shall negotiate a mutually acceptable adjustment in Contract Sum and Contract Time, as appropriate, prior to performance of the changed Work.
  2. A Contract Change Order for the stipulated amounts shall be prepared based on the stipulated sum and change in time.
- K. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
1. When agreement is reached on changes, if any, in the Contract Time and the Contract Sum, the Contractor shall prepare a Contract Change Order using a form as directed by the District, with supplementary documents as necessary to describe the change and the associated costs and schedule impacts.
  2. Construction Change Document approval is required from DSA prior to fabrication and installation.
  3. Submit Contract Change Orders to District through the Architect.
  4. Contractor shall prepare and submit five original sets of documents for each Change Order. District, Architect and Construction Manager shall sign the Change Order indicating acceptance and approval of the change.
    - a. Structural Engineer shall also sign the Change Order, when applicable.
  5. All Change Orders must be approved by DSA prior to fabrication and installation.
  6. Upon approval of the Change Order, Contractor shall promptly execute the change in the Work.
- L. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- M. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
1. Contractor shall submit revised schedules at the next Application for Payment following approval and acceptance of the Contract Change Order.
- N. Promptly enter changes in Project Record Documents.

#### **1.07 APPLICATION FOR FINAL PAYMENT**

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 01 70 00.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**





**SECTION 01 25 00**  
**SUBSTITUTION PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

**1.02 RELATED REQUIREMENTS**

- A. Division 00 - Procurement and Contracting Requirements: Restrictions on timing of substitution requests.
- B. Section 00 43 25 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).
- C. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.
- D. Section 01 33 00 – Submittal Procedures
- E. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.
- F. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Restrictions on emissions of indoor substitute products.

**1.03 DEFINITIONS**

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

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 GENERAL REQUIREMENTS**

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

documents or revision to the Drawings or Specifications for use as Construction Contract Documents.

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

- C. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
    - a. Include a signed certification that the Contractor has:
      - 1) Reviewed the proposed substitution and has determined that the substitution is equivalent or superior in every respect to product requirements indicated or product specified in the Contract Documents.
      - 2) Certify the proposed substitution is suited for and can perform the purpose or application of the specified product indicated or specified in the Contract Documents.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to District.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
    - a. Include a signed waiver by the Contractor for changes in the Contract Time or Contract Sum because of the following:
      - 1) Substitution failed to perform adequately.
      - 2) Substitution required changes in on other elements of the Work.
      - 3) Substitution caused problems in interfacing with other elements of the Work.
      - 4) Substitution was determined to be unacceptable by authorities having jurisdiction.
  - 6. Agrees to reimburse District and Architect for review or redesign services associated with re-approval by authorities.
- D. A Substitution Request for specified installer constitutes a representation that the submitter:
  - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
  - 1. Note explicitly any non-compliant characteristics.
- F. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. Forms indicated and included in the Project Manual are adequate for this purpose, and must be used.
  - 2. No specific form is required. Contractor's Substitution Request documentation must include the following:
    - a. Project Information:
      - 1) Official project name and number, and any additional required identifiers established in Contract Documents.

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

### **3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

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

### **3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

- A. Submittal Form (after award of contract):
  - 1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. After Contract award, requests will be considered for cause only; in the case of product unavailability, through no fault of the Contractor , or for reasons of cost reducing value analysis requested by the District.
  - 1. Substitutions will be considered when a product, through no fault of the Contractor, becomes unavailable or unsuitable due to regulatory change.
  - 2. Product Availability Waiver:
    - a. Failure to place orders for specified products sufficiently in advance of required date for incorporation into the Work will not be considered as a valid reason for which Contractor may request a substitution or deviation from requirements of the Drawings and Specifications.
  - 3. Waiver: At the discretion of the District, limitations on substitutions may be waived.
- C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
  - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the District through cost savings, time savings, greater energy conservation, or in other specific ways.
  - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
  - 3. Bear the costs engendered by proposed substitution of:
    - a. District's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

- b. Other construction by District.
  - c. Other unanticipated project considerations.
- E. Substitutions will not be considered under one or more of the following circumstances:
- 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  - 2. Without a separate written request.
  - 3. When acceptance will require revisions to Contract Documents.

### **3.04 CONTRACT DOCUMENT REVISIONS:**

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

### **3.05 RESOLUTION**

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

### **3.06 ACCEPTANCE**

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

### **3.07 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

### **3.08 ATTACHMENTS**

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

**END OF SECTION**





**SECTION 01 30 00**  
**ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 32 16 - Construction Progress Schedule: Form, content, and administration of schedules.
- B. Section 01 60 00 - Product Requirements: General product requirements.
- C. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- D. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.
- E. Technical Product Sections: Procedures for specific submittals specified in those Sections to be made at Contract closeout.

**1.03 DEFINITIONS**

- A. Action Submittals: Written and graphic information that requires responsive action by Construction Manager and Architect or other responsible design professional.
- B. Informational Submittals: Written information that does not require responsive action by Construction Manager and Architect or other responsible design professional.
- C. Unsolicited Submittals: Action or informational submittals not required by the Contract Documents or not requested by the reviewer. Unsolicited submittals may be returned with notation "not reviewed."

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

#### **1.04 PROJECT COORDINATOR**

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

5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE**

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

- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
  - 1. Representatives of District are scheduled and included in this training.
- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for District.

### **3.02 PRECONSTRUCTION MEETING**

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

### **3.03 SITE MOBILIZATION MEETING**

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
  - 1. Contractor.
  - 2. District.
  - 3. Architect.
  - 4. Contractor's superintendent.
  - 5. Major subcontractors.
  - 6. Inspector of Record.
- C. Agenda:
  - 1. Distribute and discuss list of subcontractors and suppliers.

2. Project Communication Procedures: Review requirements and administrative requirements for written and oral communications.
  - a. Review requirements and administrative procedures Contractor may wish to institute for identification and reporting purposes.
3. Change Procedures: Review requirements and administrative procedures for Change Orders, Construction Change Directives, Architect's supplemental instructions and Contractor's Requests for Interpretation or Information.
4. Use of premises by District and Contractor.
  - a. Site access restrictions, if any, and requirements to avoid disruption of operations at adjoining facilities or operations.
  - b. Construction Facilities and Temporary Utilities: Designate storage and staging areas, construction office areas; review temporary utility provisions; present District's requirements for use of premises.
5. District's requirements.
6. Construction facilities and controls provided by District.
7. Temporary utilities provided by District.
8. Survey and building layout.
9. Security and housekeeping procedures.
10. Schedules.
  - a. Distribute and discuss initial construction schedule and critical work sequencing of major elements of Work;
  - b. Include coordination of District Furnished / Contractor Installed (OFCl) products;
11. Application for payment procedures.
12. Procedures for testing.
13. Procedures for maintaining record documents.
14. Requirements for start-up of equipment.
15. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.

### **3.04 PROGRESS MEETINGS**

- A. Schedule and administer meetings throughout progress of the work at maximum bi-weekly intervals.
- B. Meeting Time and Location: As mutually agreed by District, Architect, and Contractor, at on-site location.
- C. Special Meetings: As necessary, Construction Manager may convene special meetings to discuss specific construction issues in detail and to plan specific activities.
  1. See Section 01 70 00 - Execution and Closeout Requirements.
- D. Attendance Required:
  1. Contractor.

2. District.
  3. Architect.
  4. Contractor's superintendent.
  5. Major subcontractors.
- E. Agenda:
1. Review minutes of previous meetings.
  2. Review of work progress.
  3. Field observations, problems, and decisions.
  4. Identification of problems that impede, or will impede, planned progress.
  5. Review of submittals schedule and status of submittals.
  6. Review of RFIs log and status of responses.
  7. Review of off-site fabrication and delivery schedules.
  8. Maintenance of progress schedule.
  9. Corrective measures to regain projected schedules.
    - a. Develop corrective measures and procedures, including but not necessarily limited to additional personnel loading to regain planned schedule.
  10. Planned progress during succeeding work period.
  11. Coordination of projected progress.
  12. Maintenance of quality and work standards.
  13. Effect of proposed changes on progress schedule and coordination.
  14. Other business relating to work.
- F. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, District, participants, and those affected by decisions made.

### **3.05 CONSTRUCTION PROGRESS SCHEDULE**

- A. Contractor's Review: All schedules shall be reviewed and approved by Contractor prior to submission for Architect's and Construction Manager's review.
- B. Reviews by Architect and Construction Manager will be to ascertain the general status of construction and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.

### **3.06 DAILY CONSTRUCTION REPORTS**

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. In addition to transmitting electronically a copy to District and Architect, submit two printed copies at weekly intervals.
  1. Submit in format acceptable to District.
  2. Submit using required form, a sample of which is appended to this section.

- C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
1. Date.
  2. High and low temperatures, and general weather conditions.
  3. List of subcontractors at Project site.
  4. List of separate contractors at Project site.
  5. Approximate count of personnel at Project site.
    - a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
  6. Major equipment at Project site.
  7. Material deliveries.
  8. Safety, environmental, or industrial relations incidents.
  9. Meetings and significant decisions.
  10. Unusual events (submit a separate special report).
  11. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
  12. Meter readings and similar recordings.
  13. Emergency procedures.
  14. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
  15. Change Orders received and implemented.
  16. Testing and/or inspections performed.
  17. List of verbal instruction given by District and/or Architect.
  18. Signature of Contractor's authorized representative.

### **3.07 PROGRESS PHOTOGRAPHS**

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
- C. Photography Type: Digital; electronic files.
- D. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- E. In addition to periodic, recurring views, take photographs of each of the following events:
  1. Completion of site clearing.
  2. Excavations in progress.
  3. Foundations in progress and upon completion.
  4. Structural framing in progress and upon completion.

5. Final completion, minimum of ten (10) photos.
- F. Take photographs as evidence of existing project conditions as follows:
  1. Interior views: each elevation, floor and ceilings prior to demolition.
  2. Exterior views: each elevation, roof and areas adjacent to construction limits.
- G. Views:
  1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
  2. Consult with Architect for instructions on views required.
  3. Provide factual presentation.
  4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
  5. Point of View Sketch: Provide sketch identifying point of view of each photograph.
- H. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
  1. Delivery Medium: Via email.
  2. File Naming: Include project identification, date and time of view, and view identification.
  3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
  4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
  5. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

### **3.08 COORDINATION DRAWINGS**

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

### **3.09 REQUESTS FOR INTERPRETATION OR INFORMATION (RFI)**

- A. Definition: A request seeking one of the following:
  1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
  2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.



- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
  2. Prepare in a format and with content acceptable to District.
    - a. Use the form provided in this project manual.
    - b. Use CSI/CSC Form 13.2A - Request for Interpretation.
  3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
    - a. Submit RFIs from subcontractors and material suppliers through, be reviewed by and be attached to an RFI prepared, signed and submitted by Contractor.
      - 1) RFIs from subcontractors and material suppliers are to be:
        - (a) Reviewed by Contractor.
        - (b) Corrected and rewritten to clarify as required by Contractor.
        - (c) Placed on the proper form, then signed, and submitted by Contractor.
        - (d) RFIs submitted directly by subcontractors or material suppliers will be returned unanswered to the Contractor.
      - 2) RFIs submitted directly by subcontractors or material suppliers will be returned unanswered to the Contractor.
    - b. Review all subcontractor- and supplier-initiated RFIs and take actions to resolve issues of coordination, sequencing and layout of the Work.
      - 1) RFIs submitted to request clarification of issues related to means, methods, techniques and sequences of construction or for establishing trade jurisdictions and scopes of subcontracts will be returned without response.
        - (a) Such issues are solely the Contractor's responsibility.
      - 2) Contractor is responsible for delays resulting from the necessity to resubmit an RFI due to insufficient or incorrect information presented in the RFI.
  2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
    - a. Approval of submittals (use procedures specified elsewhere in this section).
    - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
    - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
    - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
  4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
    - a. The District reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
  2. District's, Architect's, and Contractor's names.
  3. Discrete and consecutive RFI number, and descriptive subject/title.
  4. Issue date, and requested reply date.
  5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
  6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
    - a. Inability to determine from the Contract Documents the exact material, process, or system to be installed;
    - b. Or when the elements of construction are required to occupy the same space (interference);
    - c. Or when an item of Work is described differently at more than one place in the Contract Documents.
  7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
    - a. In all cases, furnish all information required for the Architect to analyze and/or understand the circumstances causing the RFI and prepare a clarification or direction as to proceed for RFIs issued to request clarification of issues related to:
      - 1) Means, methods, techniques and sequences of construction, for example
      - 2) Pipe and duct routing, clearances;
      - 3) Specific locations of Work shown diagrammatically;
      - 4) Apparent interferences and similar items.
      - 5) If information included with this type RFI by the Contractor is insufficient, the RFI will be returned unanswered.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
  - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
  - 2. Note dates of when each request is made, and when a response is received.
  - 3. Highlight items requiring priority or expedited response.
  - 4. Highlight items for which a timely response has not been received to date.
  - 5. Identify and include improper or frivolous RFIs.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
  - 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to District.
  - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
  - 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
  - 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
  - 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

### 3.10 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
  - 1. Submit at the same time as the preliminary schedule.
    - a. Submit initial Submittals Schedule within 14 days of date of Notice of Award of construction.
    - b. After review and return by Architect, resubmit Submittals Schedule within 10 days and thereafter submit updated Submittals Schedules at each Construction Progress Meeting.
    - c. Submit one copy each to Owner and Architect.
  - 2. Coordinate with Contractor's construction schedule and schedule of values.
  - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
    - a. Prepare schedules in Gantt format using software at Contractor's option, providing clear indication of sequencing and scheduling of Work, for determination of "critical path" of construction progress.

- 1) Submittals shall be connected to the related construction element by a graphically indicated critical path on the same page.
- 2) Present schedules using opaque reproductions on substantial paper, with sheet size a multiple of 8-1/2 by 11 inches and large enough to clearly read characters.
4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.

### **3.11 SUBMITTALS FOR REVIEW**

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

### **3.12 SUBMITTALS FOR INFORMATION**

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

### **3.13 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:

1. Project record documents.
  2. Operation and maintenance data.
    - a. Include operation and maintenance data submittals in Submittals Schedule specified above.
    - b. Provide space for review action stamps and, if required by governing authorities having jurisdiction, license seal of design Professional, if applicable.
  3. Warranties.
  4. Bonds.
  5. Other types as indicated.
- D. Submit for District's benefit during and after project completion.

### **3.14 NUMBER OF COPIES OF SUBMITTALS**

- A. Electronic Documents: Submit one electronic copy in PDF format with renderable text; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Small Size Sheets, Not Larger Than 11 by 17 inch: Submit one copy; the Contractor shall make his own copies from original returned by the Architect after making his own file copy.
- C. Extra Copies at Project Closeout: See Section 01 78 00.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
  1. After review, produce duplicates.
  2. Retained samples will not be returned to Contractor unless specifically so stated.
  3. Quantity:
    - a. Submit minimum of four (4) samples of each of color, texture and pattern.
    - b. Submit one item only of actual assembly or product.
    - c. Unless otherwise noted, full-size and complete samples will be returned and may be incorporated into field mock-ups and the Work.

### **3.15 SUBMITTAL PROCEDURES**

- A. General Requirements:
  1. Use a separate transmittal for each item.
  2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
  3. Transmit using approved form.
  4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
  5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
    - a. For example:
      - 1) 09 21 16-1 - First submittal for Section 09 21 16 - Gypsum Board Assemblies.

- 2) 09 21 16-2 - Second submittal for Section 09 21 16 - Gypsum Board Assemblies.
- b. Use same number for resubmittals as original submittal, followed by a letter indicating sequential resubmittal. For example:
  - 1) 09 21 16-2A - Resubmission of second submittal for Section 09 21 16 - Gypsum Board Assemblies.
  - 2) 09 21 16-2B - Second resubmission of second submittal for Section 09 21 16 - Gypsum Board Assemblies.
- 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
  - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
  - b. Field measurements have been determined and verified.
  - c. Conformance with requirements of Contract Drawings and Specifications is confirmed.
  - d. Catalog numbers and similar data are correct.
  - e. Work being performed by various subcontractors and trades is coordinated.
  - f. Field construction criteria have been verified, including confirmation that information submitted has been coordinated with the work being performed by others for District and actual site conditions.
  - g. All deviations from requirements of Drawings and Specifications have been identified and noted.
- 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
  - a. Send submittals in electronic format via email to Architect.
  - b. Upload submittals in electronic form to Electronic Document Submittal Service website.
- 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
  - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
  - b. For sequential reviews involving Architect's consultants, District, or another affected party, allow an additional 7 days.
- 9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
  - a. Changes in the Work shall not be authorized by submittals review actions.
  - b. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
  - c. Changes shall only be authorized by separate written Contract Change Order or Construction Change Directive, in accordance with the Conditions of the Contract and Section 01 20 00 - Price and Payment Procedures.
- 10. Provide space for Contractor and Architect review stamps.
- 11. When revised for resubmission, identify all changes made since previous submission.

12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
  13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
  14. Submittals not requested will be recognized, but will be returned without comment,
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
  2. Collect required information into a single submittal.
  3. Submit concurrently with related shop drawing submittal.
  4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
  2. Use of reproductions of the Contract Documents in digital data form to create shop drawings is only permitted as defined in Division 01 and individual product sections.
  3. Coordination: Show all field dimensions and relationships to adjacent or critical features of Work.
  4. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
  2. Samples will be reviewed for aesthetic, color, or finish selection.
  3. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
  4. Color Selection Samples: Architect will review and select colors for Project only after all colors are received, so that colors may be properly coordinated.
  5. Copies: Submit actual samples. Photographic or printed reproductions will not be accepted.
  6. Review of Field Samples: Review by Architect of field samples will be made for the following example products, as applicable, if not otherwise required and if requested by Contractor.
    - a. Concrete wall finishes and detailing (edges, corners and reveals).
    - b. Concrete paving colors and textures.
    - c. Gypsum board textures and finishes.
    - d. Field-applied paint colors and finishes.

### **3.16 SUBMITTAL REVIEW**

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
  - 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
  - 1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "Approved", or language with same legal meaning.
    - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
      - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
    - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
      - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
      - 2) Non-responsive resubmittals may be rejected.
  - 2. Not Authorizing fabrication, delivery, and installation:
    - a. "Revise and Resubmit".
      - 1) Resubmit revised item, with review notations acknowledged and incorporated.
      - 2) Non-responsive resubmittals may be rejected.
    - b. "Rejected".
      - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
  - 1. Items for which no action was taken:
    - a. "Received" - to notify the Contractor that the submittal has been received for record only.
  - 2. Items for which action was taken:
    - a. "Reviewed" - no further action is required from Contractor.

**END OF SECTION**



**SECTION 01 30 00.01  
REQUEST FOR INTERPRETATION**

**RFI NUMBER:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**PROJECT NAME:** Imperial Valley College – Building 700 HVAC Replacement **PROJECT NO.:** 19-43103-00

**TO:** SGH ARCHITECTS

707 Brookside Avenue, Redlands, California 92373

Attention: \_\_\_\_\_

Contractor: \_\_\_\_\_

Address: \_\_\_\_\_

**BRIEF SUMMARY OF RFI:** \_\_\_\_\_

Drawing No. \_\_\_\_\_ Detail No. \_\_\_\_\_

Specification Section \_\_\_\_\_ Title \_\_\_\_\_

Page \_\_\_\_\_ Paragraph \_\_\_\_\_

**DETAILS OF THIS RFI:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**SUGGESTED SOLUTION:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

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

Organization: \_\_\_\_\_

**RESPONSE:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Attachments: \_\_\_\_\_

Response By: \_\_\_\_\_ Date: \_\_\_\_\_

Organization: \_\_\_\_\_

Copies: \_\_ File \_\_ District \_\_ Structural \_\_ Mechanical \_\_ Plumbing \_\_ Electrical

**END OF RFI**



**SECTION 01 31 14**  
**FACILITY SERVICES COORDINATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 MECHANICAL AND ELECTRICAL COORDINATOR**

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

**1.04 SUBMITTALS**

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

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 COORDINATION REQUIRED**

- A. Coordinate the Work as stated in the Conditions of the Contract.
  - 1. Coordinate Work under the Contract with work under separate contracts by District.

2. Preinstallation Meetings: Coordinate and document work between trades. See Section 01 70 00 - Execution and Closeout Requirements.
  3. Cooperate with District, Construction Manager, and others as directed by District in scheduling and sequencing the incorporation into the Work of Owner Furnished / Contractor Installed (OFCI) products identified in the Contract Drawings and Specifications.
- B. Relationship of Documents:
1. Drawings, Specifications and other Contract Documents in the Project Manual are intended to be complementary.
  2. What is required by one shall be as if required by all.
  3. What is shown or required, or may be reasonably inferred to be required, or which is usually and customarily provided for similar work, shall be included in the Work.
- C. Discrepancies:
1. Error, omission, ambiguity or conflict in Drawings or Specifications shall be brought to Architect's attention during the bidding period, for Architect's determination and direction in accordance with provisions of the Conditions of the Contract.
- D. Construction Interfacing and Coordination: Layout, scheduling and sequencing of Work shall be solely the Contractor's responsibility.
1. Contractor shall verify, confirm and coordinate field measurements so that new construction correctly and accurately interfaces with conditions existing prior to construction.
- E. Contractor shall bring together the various parts, components, systems and assemblies as required for the correct interfacing and interpretation of all elements of the Work.
1. All work required to provide complete and fully operational systems shall be included in the contract price.
  2. Contractor shall coordinate Work to correctly and accurately connect abutting, adjoining, overlapping and related elements, including work under separate contracts by District, utility agencies and companies.
- F. Coordinate the work listed below:
1. Structural: Division 03, Division 04, Division 05, and Division 06.
  2. Architectural: Division 7, Division 9.
  3. Specialties: Division 10.
  4. Heating, Ventilating, and Air Conditioning: Division 23.
  5. Electrical: Division 26.
- G. Coordinate progress schedules, including dates for submittals and for delivery of products.
- H. Conduct meetings among subcontractors and others concerned, to establish and maintain coordination and schedules, and to resolve coordination matters in dispute.
- I. Participate in progress meetings. Report on progress of work to be adjusted under coordination requirements, and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.

- J. Coordination of subcontracts and separate contracts
  - 1. Superintendence of Work:
    - a. Contractor shall appoint a field superintendent and a project manager, who shall directly and full time supervise and coordinate all Work of the Contract.
  - 2. Subcontractors, Trades and Materials Suppliers:
    - a. Require all subcontractors, trades, crafts and suppliers to coordinate their portions of Work with the Contractor's field superintendent to prevent scheduling, sequencing, dimensional and other conflicts and omissions.
  - 3. Coordination with Work Under Separate Contracts:
    - a. Coordinate and schedule Work under the Contract with work being performed for Project under separate contracts by District, serving utilities and public agencies.
    - b. Make and facilitate direct contacts with parties responsible for work of the Project under separate contracts, in order to provide timely notifications and to facilitate information exchanges.

### **3.02 COORDINATION DOCUMENTS**

- A. Prepare coordination drawings to organize installation of products for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.
  - 1. Produce BIM Drawings for the proposed installation and the placement of pipes, conduits, other materials, and the locations, size and reinforcement of penetrations in the building structure to conform to the structural Drawing and Specifications.
  - 2. Structural requirements take precedence when the requirements of the Mechanical, Electrical or other items are in conflict with structural.
  - 3. Take all precautions prior to coring into an existing building structure.
  - 4. Notify the structural engineer and obtain written approval prior to completing any structural penetrations if the structural integrity of an existing or new building structure may be compromised. Refer to Section 01 70 00 - Execution and Closeout Requirements for cutting and patching.
  - 5. Review limitations in available space for installation or service.
    - a. Overlay plans of each trade and verify space requirements and conflicts between trades.
    - b. Minor changes and adjustments that do not affect design intent may be made by Contractor and highlighted for Architect's review prior to purchase and installation.
  - 6. Incompatibility between items provided under different trades.
  - 7. Inconsistencies between drawings, specifications and codes (between trades and within each trade).
- B. Prepare a master schedule identifying responsibilities for activities that directly relate to this work, including submittals and temporary utilities; organize by specification section.
- C. Verify that utility, and other building system requirement characteristics of operating equipment are compatible with provided utilities, and other building systems.
  - 1. Coordinate work of various trades having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

- D. Identify electrical power characteristics and control wiring required for each item of equipment.
- E. Maintain documents for the duration of the work, recording changes due to site instructions, modifications or adjustments.
- F. After Architect review of original and revised documents, reproduce and distribute copies to concerned parties.

### **3.03 COORDINATION DRAWINGS / BIM MODEL**

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

### **3.04 COORDINATION OF SUBMITTALS**

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

### **3.05 COORDINATION OF SUBSTITUTIONS AND MODIFICATIONS**

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

### **3.06 OBSERVATION OF WORK**

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

### **3.07 DOCUMENTATION**

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

### **3.08 EQUIPMENT START-UP**

- A. Verify utilities, connections, and controls are complete and equipment is in operable condition as required by Section 01 70 00.
- B. Observe start-up and adjustments, test run, record time and date of start-up, and results.
- C. Observe equipment demonstrations made to District; record times and additional information required for operation and maintenance manuals.

### **3.09 INSPECTION AND ACCEPTANCE OF EQUIPMENT**

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

**END OF SECTION**



**SECTION 01 32 16**  
**CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED SECTIONS**

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

**1.03 REFERENCE STANDARDS**

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2015.

**1.04 SUBMITTALS**

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

**1.05 QUALITY ASSURANCE**

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one year's minimum experience in scheduling construction work of a complexity comparable

to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1. Designate the Scheduler in writing and within ten (10) workdays after Notice of Intent to Award, as the qualified responsible person for preparation, maintenance, updating, and revision of all schedules for the full term of construction.
  2. Scheduler:
    - a. Dedicated to this project and available on-site as needed to meet the strict requirement of this spec. section.
    - b. All scheduling software and hardware located on-site.
    - c. Scheduler will attend all project meetings called for as specified in Section 01 30 00.
  3. Qualifications of responsible person:
    - a. Knowledge of critical path method (CPM) scheduling utilizing Primavera P6 latest release software.
  4. References:
    - a. Submit written reference of three (3) project Owners who have personal experience with this scheduler on previous projects.
    - b. Identify name, address, telephone number, project name, and cost.
  5. Construction Manager reserves the right to disapprove Scheduler when submitted by Contractor based on his/or her sole discretion. Construction Manager reserves the right to remove Scheduler from the project without cause.
- B. Contractor's Administrative Personnel: Three years minimum experience in using and monitoring CPM schedules on comparable projects.
- C. Reviews by Architect and Construction Manager: Reviews by Architect and Construction Manager will be to ascertain the general status of construction and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.
- D. Contractor's Review: All schedules shall be reviewed and approved by Contractor prior to submission for Architect's and Construction Manager's review.
- E. Changes and Deviations: Identify all deviations from requirements of Drawings and Specifications.
1. Changes in the Work shall not be authorized by submittals review actions.
  2. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
  3. Changes shall only be authorized by separate written Change Order or Field Change Directive, in accordance with the Conditions of the Contract.

#### **1.06 SCHEDULE FORMAT**

- A. Format: Prepare schedules in format at Contractor's option, either bar chart, PERT or GANTT format, providing clear indication of sequencing and scheduling of Work, for determination of "critical path" of construction progress.
1. Prepare schedules in MS Project or Primavera.
  2. Provide clear indication of sequencing and scheduling of work for determination of "critical path" of construction progress.

3. Present schedule in both electronic and reproducible paper formats with sheet size large enough to clearly read the characters.
- B. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- C. Diagram Sheet Size: Maximum 22 x 17 inches.
- D. Sheet Size: Multiples of 8-1/2 x 11 inches.
- E. Scale and Spacing: To allow for notations and revisions.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 PRELIMINARY SCHEDULE**

- A. Prepare preliminary schedule in the form of a horizontal bar chart.
- B. Prescheduling Conference:
  1. Construction Manager will conduct a conference within fifteen (15) work days after the Notice of Intent to Award to comply with requirements in Section 01 30 00 - Administrative Requirements.
    - a. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
      - 1) Review software limitations and content and format for reports.
      - 2) Verify availability of qualified personnel needed to develop and update schedule.
      - 3) Discuss constraints, including phasing work stages area separations interim milestones and partial District occupancy.
      - 4) Review delivery dates for District-furnished products.
      - 5) Review schedule for work of District's separate contracts.
      - 6) Review submittal requirements and procedures.
      - 7) Review time required for review of submittals and resubmittals.
      - 8) Review requirements for tests and inspections by independent testing and inspecting agencies.
      - 9) Review District's IT requirements for installation of their Work.
      - 10) Review time required for Project closeout and District startup procedures, including commissioning activities for MEP, Security Electronics Equipment.
      - 11) Review and finalize list of construction activities to be included in schedule.
      - 12) Review procedures for updating schedule.
- C. At the meeting, the Construction Manager will review scheduling requirements. These include schedule preparation, reporting requirements, labor and equipment loading, updates, revisions, and schedule delay analysis.
  1. The Contractor will present schedule methodology, planned sequence of operations, resource loading methodology, and proposed activity coding structure.
- D. Coding structure:

1. Submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the project schedule.
2. A minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work, Submittal/Procurement/Construction and Responsibility/Subcontractor.
  - a. Refer to NETWORK DETAILS AND GRAPHICAL OUTPUT for listing of activity categories to be included in the schedule.

### 3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
  1. Identify Work of separate buildings, phases, units or other logically grouped activities to facilitate review of Application for Payment with completed Work.
- D. Provide sub-schedules for each stage of Work identified in Section 01 10 00 - Summary.
- E. Provide sub-schedules to define critical portions of the entire schedule.
- F. Include conferences and meetings in schedule.
- G. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- H. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
  1. Format: Prepare Submittals Schedule in a format comparable to Construction Progress Schedule, specified in Article above.
  2. Content: List all items specified to be submitted, indicating submittal number (see instructions specified in Section 01 30 00 - Administrative Requirements, submittal type (i.e., product data, shop drawings, sample, quality control report, maintenance and operating data, etcetera), scheduled date submittal is to be made and date review should be complete in order to maintain construction on schedule.
  3. The Contractor shall submit to the Architect a schedule of the shop drawings that lists their required submission and approval dates.
    - a. Allow minimum one (1) week for the Architect to review the submittals. Some submittals may require a longer review period. See Section 01 30 00 - Administrative Requirements.
    - b. Allow for the possibility that the consultant team will request revisions and resubmittal following the initial submittal.
    - c. The schedule shall encompass the entire construction period and will be revised by the Contractor and reviewed by the project team at each project meeting.
  4. Changes and Deviations: Identify all deviations from requirements of Drawings and Specifications.
    - a. Changes in the Work shall not be authorized by submittals review actions.

- b. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
  - c. Changes shall only be authorized by separate written Change Order or Construction Change Directive, in accordance with the Conditions of the Contract and Section 01 20 00 - Price and Payment Procedures.
- 5. Administration: Review of Submittals Schedules by Architect, Construction Manager, and District will be to ascertain the general status of submittals review and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.
  - a. Submit one copy each to Construction Manager and Architect.
  - b. Submit initial Submittals Schedule within 14 days of construction start date established in Notice to Proceed.
  - c. After review, resubmit Submittals Schedule within 10 days and thereafter submit updated Submittals Schedules at each Construction Progress Meeting.
- I. Indicate delivery dates for owner-furnished products.
- J. Coordinate content with schedule of values specified in Section 01 20 00 - Price and Payment Procedures.
  - 1. Include Submittals Schedule.
- K. Provide legend for symbols and abbreviations used.

### **3.03 BAR CHARTS**

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

### **3.04 NETWORK ANALYSIS**

- A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.
- B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
- C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
  - 1. Preceding and following event numbers.
  - 2. Activity description.
  - 3. Estimated duration of activity, in maximum 15 day intervals.
  - 4. Project Milestones; include "Project Start" and "End Project" Millstones.
    - a. Schedule starts no earlier than the Project Duration (Day 1) will start on the Notice To Proceed (NTP) date.
  - 5. Earliest start date.
  - 6. Earliest finish date.
  - 7. Actual start date.

- a. "Project Start" Milestone to have no predecessors and "End Project" Milestone has no successors.
  - b. "Project Start": Constrained by a "Mandatory Start" Milestone.
  - c. "End Project": Constrained by a "Mandatory Finish" Milestone.
  - d. No other activities on the schedule may have constraints, unless reviewed and approved by Construction Manager and Architect.
- 8. Actual finish date.
  - 9. Latest start date.
  - 10. Latest finish date.
  - 11. Total and free float; float time shall accrue to District and to District's benefit.
    - a. Contractor does not own the float.
    - b. "Float time" refers to the time between earliest finish date and the latest finish date of each activity shown on the Construction Schedule.
    - c. Any float time indicated in the Construction Schedules required by this Section are to be held jointly by the District and Contractor.
    - d. Any delay (including District caused) encountered is to be subtracted from the available days ahead of progress against the Construction Schedule.
      - 1) District may claim float days equal to the delay until such float days are exhausted.
      - 2) No compensation of any type will be due the Contractor until the delay extends the overall project substantial completion date.
    - e. Weather (Rain) day requirements are as specified in the "Construction Services Agreement."
  - 12. Monetary value of activity, keyed to Schedule of Values.
  - 13. Percentage of activity completed.
  - 14. Responsibility.
- D. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, accepting revised completion dates, and recomputation of all dates and float.
  - E. Required Reports: List activities in sorts or groups:
    - 1. By preceding work item or event number from lowest to highest.
    - 2. By amount of float, then in order of early start.

### **3.05 CREW SCHEDULES**

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

### **3.06 WEATHER DAYS ALLOWANCE- AS ANTICIPATED BY THE CONTRACTOR**

- A. Based on historical weather in the local area, the Baseline Schedule shall include all non-work days on which the Contractor anticipates Work will not be performed due to adverse weather days that are anticipated to occur within the work day calendar and impact critical activities.

- B. The Contractor shall not receive any additional compensation for unavoidable delays due to inclement or unsuitable weather, and no time extension to complete any Contractual Completion Events as defined in General Conditions, will be considered due to inclement or unsuitable weather or conditions resulting there from.

### **3.07 REVIEW AND EVALUATION OF SCHEDULE**

- A. Review all schedules reviewed and approved by Contractor prior to submission for review by Architect and District.
- B. Participate in joint review and evaluation of schedule with Construction Manager and Architect at each submittal.
- C. Evaluate project status to determine work behind schedule and work ahead of schedule.
- D. After review, revise as necessary as result of review, and resubmit within 10 days.
- E. Review by Architect and District will be to ascertain the general status of construction and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.

### **3.08 SUMMARY SCHEDULE**

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

### **3.09 WEEKLY (SHORT TERM LOOK-AHEAD) SCHEDULE**

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

### 3.10 UPDATING SCHEDULE

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

### 3.11 ADJUSTMENT OF CONTRACT TIMES

- A. Subject to the terms of General Conditions, contract time will be adjusted only for causes specified as generally described below.
  - 1. Non-excusable delay:
    - a. Includes actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility that would independently delay the completion of the Work beyond the current Contract completion date.
      - 1) This also includes actions or inactions of subcontractors, suppliers, or material manufacturers at any tier.
    - b. No time extensions will be granted for non-excusable delays.
  - 2. Excusable delay:
    - a. Events which are unforeseeable, outside the control of, and without the fault or negligence of either the District or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date.
    - b. The Contractor is entitled to a time extension only.
    - c. No other damages will be approved.
  - 3. Compensable delay:
    - a. Actions or inactions of the District, or events for which the District has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date.
    - b. The Contractor is entitled to a time extension and delay damages.
  - 4. Concurrent delay:
    - a. Any combination of the above three (3) types of delay occurring on the same calendar date, or cases where the combination consists of two (2) or more instances of the same type of delay occurring on the same calendar date.
      - 1) Exception to concurrent delay:
        - (a) When one cause of delay is District-caused or caused by an event which is beyond the control and without the fault or negligence of either the



District or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

- B. If the Contractor believes that the District has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path.
  - 1. Proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.
- C. Notify Construction Manager of a potential request for Contract Time adjustment within five (5) days of the start of the impact.
- D. The Contractor shall prepare and submit along with any Change Order Request (COR), response to Request for Proposal/Quote (RFP/RFQ), Differing Site Condition (DSC) notification or Request for Additional Compensation (RAC) a Time Impact Analysis (TIA) which includes both a written narrative and a schedule diagram depicting how the changed work may affect the progress of work and other schedule activities.
  - 1. The schedule diagram shall show how the Contractor proposes to incorporate the changed work in the schedule, and how it impacts the current updated schedule and critical path.
  - 2. The TIA shall not be resource constrained, or leveled using resource limits.
  - 3. Failure to include a TIA with the COR, Proposal, Quote, DSC or RAC shall constitute a waiver of the right to later claim any adjustment in time based upon changed or unforeseen Work.
- E. Time Impact Analysis (TIA):
  - 1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other District-caused delay). Represent the delay event in the schedule by:
    - a. Inserting new activities associated with the delay event into the schedule.
    - b. Revising activity logic.
    - c. Revising activity durations.
  - 2. If the project schedule's critical path and milestone date(s) are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact without resource constraints may be warranted.
  - 3. The Time Impact Analysis submittal must include the following information:
    - a. A fragment of the portion of the schedule affected by the delay event.
    - b. A narrative explanation of the delay issue and how it impacted the schedule.
    - c. A digital file containing the schedule file used to perform the Time Impact Analysis.
- F. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.
- G. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.

1. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.
- H. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
  1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.
- I. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.
- J. Submit request as specified with Contract Documents.
  1. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.
- K. The Construction Manager will, within five (5) working days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
  1. Include the new Progress Schedule data, if accepted by the District, in the next monthly Schedule Update.
  2. When the District has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Construction Manager may accept as appropriate for such interim purpose.
    - a. It is understood and agreed that any such interim acceptance by the Construction Manager shall not be binding.
    - b. Interim acceptance shall be made only for the purpose of continuing to schedule the Work
    - c. Interim acceptance shall remain until such time as a final determination as to any adjustment of the Contract Time acceptable to the Construction Manager has been made.
    - d. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

### **3.12 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Construction Manager, Architect, District, and other concerned parties.
- B. Posting: Post one copy, minimum, of most recent Construction and Submittals Schedules in the Contractor's jobsite office, readily available to Construction Manager and Architect.

- C. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.
- D. Archive: Preserve a minimum of two copies of all superseded schedules, with a minimum of one copy available at job office for review by Construction Manager or Architect.

**3.13 FINAL SCHEDULE SUBMITTAL**

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

**END OF SECTION**



## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Submittal Procedures
- B. Shop Drawings
- C. Product Data
- D. Samples
- E. Manufacturers' Instructions
- F. Manufacturers' Certificates
- G. Coordinated Drawings

##### 1.2 SUBMITTAL PROCEDURES

- A. Transmit separate request for each submittal directly to the General Contractor.
  - 1. Bind submittals sturdily, neatly label covers.
  - 2. Include Architect job number as it appears on Contract Documents.
  - 3. Include state agency application or approval number.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and Specification Section number, as appropriate.
  - 1. Provide name and telephone number of individuals who may be contacted for further information.
- D. Apply Contractor's dated stamp with Contractor's original signature or initials affixed thereto, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Stamped signatures or initials are not acceptable.
- E. Schedule submittals to expedite the Project. Coordinate submission of related items.
  - 1. Make all submittals in accordance with the progress schedule and far enough in advance of scheduled dates of installation to provide required time for reviews for securing necessary approvals for possible revision and resubmittal and for placing orders and securing delivery.
- F. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- G. State effect of substitution on construction schedule, and changes required in other work or products.
- H. Provide space for Contractor and Architect review stamps.
- I. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- J. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

- K. Determine and verify all field dimensions and conditions, materials, catalog numbers and similar data.
- L. Coordinate as required with all trades and all public agencies involved.
- M. Unless otherwise specifically authorized by Architect, make all submittals in groups containing all associated items. Architect may reject partial submittals as not complying with the provisions of this section.

### **1.3 SHOP DRAWINGS**

- A. Submit a schedule of the shop drawings, listing their required submission and review dates to the Architect for review and acceptance. The schedule shall allow sufficient time for checking by the Architect. In addition, the shop drawing submission and review dates shall be incorporated into the progress schedule required in the General Conditions.
- B. Submit newly prepared information, drawn to accurate scale. Highlight, encircle or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project will not be approved as Shop Drawings.
- C. Shop Drawings shall include fabrications and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
  - 1. Dimensions
  - 2. Identification of products and materials included.
  - 3. Compliance with specified standards.
  - 4. Notation of coordination requirements.
  - 5. Notation of dimensions established by field measurement.
- D. Sheet Size: Except for templates, patterns and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 inch x 11 inch, but not larger than 30 inch x 42 inch.
- E. The Contractor shall review, stamp with his approval as herein required, and submit with reasonable promptness and in orderly sequence, in accordance with the submittal schedule, all shop drawings required by the Contract Documents or subsequently by the Architect as covered by modifications. Shop drawings shall be properly identified. At the time of submission, the Contractor shall inform the Architect in writing of any deviation in the shop drawings from the requirements of the Contract Documents.
- F. Stamp: Each page of shop drawings shall bear the Contractor's stamp, which shall signify the Contractor's representation that he has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained in the shop drawings. Each stamp shall be accompanied by a wet signature or initial of an employee of the Contractor who may be contacted for information. Stamped signatures or initials are not acceptable.
- G. Method of Review: Make initial submittal of two blue-line prints and one sepia transparency of the shop drawings. Comments or corrections will be noted on the transparency and returned to the Contractor, who shall identify all changes made since the previous submittal and resubmit in the same manner. When reviewed, the transparency will be stamped and returned to the Contractor who shall make distribution of copies as required.
- H. The Architect will review shop drawings with reasonable promptness so as not to cause any

delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. The Architect's favorable review of a separate item shall not indicate acceptance of an assembly in which the item functions.

- I. Submittal of shop drawings to the Architect shall be made by the Contractor with a dated transmittal form or letter, and not by subcontractors or suppliers.
- J. The Architect's review of shop drawings shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the Architect in writing of such deviation at the time of submission and the Architect has given written acceptance to the specific deviation, nor shall the Architect's favorable review relieve the Contractor from responsibility for errors or omissions in the shop drawings.
- K. No portion of work requiring shop drawings shall be commenced until the shop drawings have been returned with a favorable review by the Architect.

#### **1.4 PRODUCT DATA**

- A. Submit six (6) copies. One (1) copy will be retained by the Architect.
- B. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. After review, distribute and provide copies for Record Documents.

#### **1.5 SAMPLES**

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Submit samples of finishes from the full range of manufacturers' standard colors, textures and patterns for Architect selection, or in custom colors selected.
- C. Include identification on each sample with full Project information.
- D. Submit a minimum of six (6) samples or as specified in individual sections of the specifications, three of which will be retained by the Architect.
- E. Reviewed samples which may be used in the Work are indicated in individual specification Sections.
- F. Selection or rejection of samples will be made by the Architect in writing.

#### **1.6 MANUFACTURER'S INSTRUCTIONS**

- A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

#### **1.7 MANUFACTURER'S CERTIFICATES**

- A. When specified in individual specification Sections, submit manufacturers' certificate to Architect for review in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be

acceptable to Architect.

### **1.8 COORDINATED DRAWINGS**

- A. Submit drawings which indicate routing, locations, sizes, types and numbers of components in concealed spaces where potential conflict may occur between structures, mechanical, electrical, fire sprinklers, communications and ceiling suspension systems.
- B. Indicate locations of all ceiling penetrations and surface-mounted items. Provide cross sections at all areas to indicate proper support of ceilings and non-interference with work of other sections of the specifications. Cross sections shall indicate coordination required and proposed solutions for routing of elements where potential conflict exists. Reproduction of Architect's reflected ceiling plan is not acceptable.
- C. Drawings shall be based on field measurements, shop drawings and product data.
- D. Conflicts shall be brought to Architect's attention immediately.
- E. Submit to the General Contractor, in writing, requests for clarification or interpretations that will affect the intent of the Contract Documents.
- F. The coordinated drawings shall indicate each class of work in the affected area. The drawing or written submittal shall include Contractor's recommendations for the solution of any potential conflicts as well as recommendations tendered by any work of any section of the specifications which may be affected thereby.
- G. Submit the coordinated drawings in a scale of not less than  $1/8" = 1' - 0"$  with necessary sections and profiles at an appropriate, clearly readable enlarged scale. Submit the coordinated drawings as one reproducible and two blue-line prints.
- H. The Architect will review the submittals, make appropriate notations and comments to ensure the solution meets the intent of the Contract Documents and then return to Contractor for implementation.
- I. The Contractor shall be responsible for the proper coordination of the work of all sections of the specifications in the execution of coordinated drawing. Any installation of materials, components or equipment under one section of the specifications without full and complete, agreement, knowledge and consent by fabricators of adjacent or otherwise related or affected work will not be approved.
- J. It shall be incumbent upon the Contractor that all fabricators of work involved in the execution of coordinated drawings be informed, consulted and advised in sufficient advance time to arrive at solutions where no extension of contract time or extra cost to the Owner will be approved due to Contractor's negligence in the expeditious, timely submittal of coordinated drawings.

### **PART 2 - PRODUCTS**

**NOT USED**

### **PART 3 - EXECUTION**

**NOT USED**

**END OF SECTION**



**SECTION 01 35 50**  
**REQUESTS FOR ELECTRONIC FILES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED SECTIONS**

- A. Section 01 30 00 - Administrative Requirements: Shop Drawings, Product Data and Samples.
- B. Section 01 70 00 - Execution and Closeout Requirements.
- C. Divisions 31 through 32 - Site Work.

**1.03 REQUIREMENTS**

- A. Electronic files have legal ramifications as information therein can be modified.
- B. In order to receive this electronic information, the following Hold Harmless Agreement form must be executed in its entirety, including signature by a company officer.
- C. Costs for processing and handling electronic files, however limited, will be \$250.00

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

**PART 3 - EXECUTION**

**3.01 ELECTRONIC FILE TRANSFER PROCEDURE**

- A. Submit a check in the amount of \$250.00 along with a list of the requested sheet numbers and an acknowledged copy of this waiver to the office of the Architect, SGH Architects, 707 Brookside Avenue, Redlands, California 92373.
- B. In order to expedite the transfer, upon receipt of a PDF copy of this acknowledgement, the requested CAD/Revit/BIM files will be sent in the form of a compact disc, DVD, or thumb drive to the recipient, as requested, by UPS, similar delivery service, or other method of electronic transfer after payment is received.
- C. It is expressly understood that any transfer is done as a courtesy and can be revoked at any time by the Architect.

**HOLD HARMLESS AGREEMENT**

**ARCHITECT'S PROJECT: IMPERIAL VALLEY COLLEGE – BUILDING 700 HVAC REPLACEMENT**

**ARCHITECT'S PROJECT NUMBER: 19-43103-00**

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

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

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

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

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

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

Acknowledged by:

\_\_\_\_\_  
Signature of Company Officer                      Print or Type Name                      Date

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Street Address    City, State, Zip Code

\_\_\_\_\_  
E-mail Address

END OF SECTION

**SECTION 01 35 53**  
**SECURITY PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 SECURITY PROGRAM**

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

**1.04 ENTRY CONTROL**

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

**1.05 PERSONNEL IDENTIFICATION**

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

**1.06 GUARD SERVICE**

- A. Employ uniformed guard service to provide watch persons at site during all non-working hours.

- B. The phone number for security is \_\_\_\_\_.
- C. All personnel must obey and act immediately upon any request by security.
- D. In an emergency, from inside the facility, dial \_\_\_\_\_. Outside the facility, dial 911.

**1.07 RESTRICTIONS**

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

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 40 00**  
**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 00 01 02 – Project Information
- B. Section 01 33 00 - Submittal Procedures.
- C. Section 01 42 19 - Reference Standards.
- D. Section 01 45 33 - Code Testing, Special Inspection and Procedures: Testing laboratory services and inspections required by Division of the State Architect (DSA), during the course of construction.
- E. Section 01 60 00 - Product Requirements: Requirements for material and product quality.
  - 1. Product options, substitutions, transportation and handling requirements, storage and protection requirements, and system completeness requirements.

**1.03 REFERENCE STANDARDS**

- A. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2017.

**1.04 DEFINITIONS**

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

**1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES**

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
  - 1. Temporary sheeting, shoring, or supports.
  - 2. Temporary scaffolding.

3. Temporary bracing.
4. Temporary falsework for support of spanning or arched structures.
5. Temporary stairs or steps required for construction access only.
6. Temporary hoist(s) and rigging.
7. Investigation of soil conditions to support construction equipment.

#### **1.06 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for District's information.
  1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
    - a. Full name.
    - b. Professional licensure information.
    - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Quality Control Submittals Schedule
  1. Schedule Format: Include quality control submittals on Submittals Schedule specified in accordance with General Conditions
  2. Schedule Content: List all tests, inspections and reports specified to be submitted, indicating submittal number, submittal type (field test, field inspection, fabrication inspection, etcetera), scheduled date of quality control activity and date report should be made.
- D. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for District's information.
  1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
  2. Include required product data and shop drawings.
  3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
  4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- E. Test Reports: After each test/inspection, promptly submit two copies of report to Architect, DSA, and to Contractor.
  1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.

- e. Identification of product and specifications section.
  - f. Location in the Project.
  - g. Type of test/inspection.
  - h. Date of test/inspection.
  - i. Results of test/inspection.
  - j. Compliance with Contract Documents.
  - k. When requested by Architect, provide interpretation of results.
2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for District's information.
- F. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
- 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- G. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the District's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- H. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for District.
- 1. Submit report in duplicate within 30 days of observation to Architect for information.
  - 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
- I. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for District.
- 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
  - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or District.

### **1.07 QUALITY ASSURANCE**

- A. Testing Agency Qualifications:
- 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

3. Qualification Statement: Provide documentation showing testing laboratory is approved by Division of the State Architect.
  4. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in California.
- C. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
    - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
      - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
    - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
      - 1) Management and control of documents and records relating to quality.
      - 2) Communications.
      - 3) Coordination procedures.
      - 4) Resource management.
      - 5) Process control.
      - 6) Inspection and testing procedures and scheduling.
      - 7) Control of noncomplying work.
      - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
      - 9) Control of testing and measuring equipment.
      - 10) Project materials certification.
      - 11) Managerial continuity and flexibility.
    - c. District will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
    - d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. District's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. District reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.
- D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.



## **1.08 REFERENCES AND STANDARDS - SEE SECTION 01 42 19**

## **1.09 REGULATORY REQUIREMENTS FOR TESTING AND INSPECTION**

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

## **1.10 TESTING AND INSPECTION AGENCIES AND SERVICES**

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

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 CONTRACTOR'S QUALITY ASSURANCE**

- A. Quality Requirements: Work shall be accomplished in accordance with quality requirements of the Drawings and Specifications, including, by reference, all Codes, laws, rules, regulations and standards. When no quality basis is prescribed, the quality shall be in accordance with the best accepted practices of the construction industry for the locale of the Project, for projects of this type.

- B. Quality Control Personnel: Contractor shall employ and assign knowledgeable and skilled personnel as necessary to perform quality control functions to ensure that the Work is provided as required.

### **3.02 CONTROL OF INSTALLATION**

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

### **3.03 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### **3.04 TESTING AND INSPECTION**

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
  - 1. Test samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products in accordance with specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
  - 6. Perform additional tests and inspections required by Architect.
  - 7. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the Work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
  - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  - 3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  - 6. Arrange with District's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

- 7. Inspections and Tests by Authorities Having Jurisdiction:
  - a. Contractor shall cause all tests and inspections to be made for Work under this Contract, as required by Building Departments, Department of Public Works, Fire Department, Health Department and similar agencies having jurisdiction.
  - b. Excepted as specifically noted, scheduling, conducting and paying for such inspections shall be solely the Contractor's responsibility.
- 8. Inspections and Tests by Serving Utilities:
  - a. Contractor shall cause all tests and inspections required by serving utilities to be made for Work under this Contract.
  - b. Scheduling, conducting and paying for such inspections shall be solely the Contractor's responsibility.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

**3.05 MANUFACTURERS' FIELD SERVICES**

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

**3.06 FIELD QUALITY CONTROL SUBMITTALS**

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

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

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

### **3.07 ARCHITECT'S REVIEW**

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

### **3.08 DEFECT ASSESSMENT**

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

**END OF SECTION**

**SECTION 01 41 00**  
**REGULATORY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 AUTHORITY AND PRECEDENCE OF CODES, ORDINANCES AND STANDARDS**

- A. Authority: All codes, ordinances and standards referenced in the Drawings and Specifications shall have the full force and effect as though printed in their entirety in the Specifications.
- B. Precedence:
  - 1. Where specified requirements differ from the requirements of applicable codes, ordinances and standards, the more stringent requirements take precedence.
  - 2. Where the Drawings or Specifications require or describe products or execution of better quality, higher standard or greater size than required by applicable codes, ordinances and standards, the Drawings and Specifications take precedence so long as such increase is legal.
  - 3. Where no requirements are identified in the Drawings or Specifications, comply with all requirements of applicable codes, ordinances and standards of authorities having jurisdiction.
- C. Applicable Codes, Laws and Ordinances: Refer also to Section 01 10 00 - Summary, regarding permits and licenses.
  - 1. Performance of the Work is be governed by all applicable laws, ordinances, rules and regulations of Federal, State and local governmental agencies and jurisdictions having authority over the Project, including accessibility requirements.
  - 2. Performance of the Work shall be accomplished in conformance with all rules and regulations of public utilities, utility districts and other agencies serving the development.
  - 3. Where such laws, ordinances, rules and regulations require more care or greater time to accomplish Work, or require better quality, higher standards or greater size of products, Work shall be accomplished in conformance to such requirements with no change to the Contract Time and Contract Sum, except where changes in laws, ordinances, rules and regulations occur subsequent to the execution date of the Agreement.
- D. Applicable Building Codes: References on the Drawings or in the Specifications to "code" or "building code" not otherwise identified shall mean the codes specified below, together with all additions, amendments, changes, and interpretations adopted by code authorities of the jurisdiction having authority over the Project.
- E. Performance of the Work shall meet or exceed the minimum regulatory requirements applicable to this project are summarized in this section, as adopted by Division of the State Architect:
  - 2019 BUILDING STANDARDS ADMINISTRATIVE CODE, PART 1, TITLE 24 C.C.R.
  - 2019 CALIFORNIA BUILDING CODE (CBC), PART 2, TITLE 24 C.C.R.
  - 2019 CALIFORNIA ELECTRICAL CODE (CEC), PART 3, TITLE 24 C.C.R.
  - 2019 CALIFORNIA MECHANICAL CODE (CMC), PART 4, TITLE 24 C.C.R.
  - 2019 CALIFORNIA PLUMBING CODE (CPC), PART 5, TITLE 24 C.C.R.
  - 2019 CALIFORNIA ENERGY CODE (CEC),PART 6, TITLE 24 C.C.R.

- 2019 CALIFORNIA FIRE CODE, PART 9, TITLE 24 C.C.R.
  - 2019 CALIFORNIA GREEN BUILDING STANDARDS CODE, PART 11, TITLE 24 C.C.R.
  - 2019 CALIFORNIA REFERENCED STANDARDS, PART 12, TITLE 24 C.C.R.
  - TITLE 19 C.C.R., PUBLIC SAFETY, STATE FIRE MARSHAL REGULATIONS
  - 2016 ASME A17.1 SAFETY CODE FOR ELEVATORS AND ESCALATORS
- F. Erosion and Sedimentation Control Regulations: .
1. California Codes and Regulations; Title 24, California Building Code, Parts 1 & 2.
  2. State of California State Water Resources Control Board Regulations.
  3. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.

**1.02 SUMMARY OF REFERENCE STANDARDS**

- A. Regulatory requirements applicable to this project are the following:
- B. Not Used
- C. 28 CFR 35 - Nondiscrimination on the Basis of Disability in State and Local Government Services; Final Rule; Department of Justice; current edition.
- D. 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice; current edition.
- E. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- F. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- G. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

**1.03 RELATED REQUIREMENTS**

- A. Section 01 40 00 - Quality Requirements.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 01 42 19**  
**REFERENCE STANDARDS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements relating to referenced standards.

**1.02 QUALITY ASSURANCE**

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

**PART 2 CALIFORNIA DEPARTMENT OF GENERAL SERVICES, DIVISION OF THE STATE ARCHITECT**

**2.01 INTERPRETATION OF REGULATIONS**

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

**PART 3 UNITED STATES GOVERNMENT AND RELATED AGENCIES DOCUMENTS**

**3.01 CFR -- CODE OF FEDERAL REGULATIONS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. 16 CFR 260.13 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; Recycled Content; Current Edition.
- C. AGC (CPSM) - Safety Standard for Architectural Glazing Materials; current edition.
- D. 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice; current edition.
- E. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

- F. 29 CFR 1910, Subpart D - Walking-Working Surfaces, 1910.21-1910.30; current edition.
- G. 29 CFR 1910.23 - Ladders; current edition.
- H. 29 CFR 1910.28 - Duty to have Fall Protection and Falling Object Protection; Current Edition.
- I. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- J. 29 CFR 1910.38 - Emergency action plans; current edition.
- K. 29 CFR 1910.132-138 - Plastic Pipe: Qualifying Persons to Make Joints; current edition.
- L. 29 CFR 1910.134 - Respiratory protection; current edition.
- M. 29 CFR 1926.62 - Lead; current edition.
- N. 29 CFR 1926.1101 - Asbestos; Current Edition.
- O. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- P. 39 CFR 111 - U.S. Postal Service Standard 4C; Current Edition.
- Q. AHRI 340/360 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500 MM (12- to 60-in.) Diameter; 2013.
- R. 40 CFR 60 - Standards of Performance for New Stationary Sources; Current Edition.
- S. 40 CFR 273 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2005.
- T. 40 CFR 280 - Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks; current edition.
- U. 40 CFR 761 - Water Resistance: Hydrostatic Pressure Test; 2014.
- V. 47 CFR 15 - Electrostatic Propensity of Carpets; 2011.
- W. 47 CFR 68 - Connection of Terminal Equipment to the Telephone Network; Current Edition .
- X. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.
- Y. AAMA 1402 - Test Method for Colorfastness to Light; 2004.
- Z. 49 CFR 192.285 - Plastic Pipe: Qualifying Persons to Make Joints; current edition.

### **3.02 CPSC -- CONSUMER PRODUCTS SAFETY COMMISSION**

- A. CPSC Pub. No. 325 - Public Playground Safety Handbook; 2010.

### **3.03 EPA -- ENVIRONMENTAL PROTECTION AGENCY**

- A. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- B. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.
- C. EPA 600-4-790-20 - Methods for Chemical Analysis of Water and Wastes; 1983.
- D. EPA 625/1-86/021 - Design Manual: Municipal Wastewater Disinfection; 1986.
- E. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999.

- F. EPA 712-C-02-190 - Health Effects Test Guidelines OPPTS 870.1100 Acute Oral Toxicity; 1996.

### **3.04 FDA -- FOOD AND DRUG ADMINISTRATION**

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

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

- A. FEMA (MAPS) - FEMA Map Service Center; Current Edition.
- B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.
- C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.

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

- A. FED-STD-595C - Colors Used in Government Procurement (Fan Deck); 2008 (Chg Notice 1).
- B. FS L-F-001641 - Floor Covering Translucent or Transparent Vinyl Surface with Backing; 1971, and Amendment 2, 1982.
- C. FS L-S-125 - Screening, Insect, Nonmetallic; 1972b, with Notice (1987).
- D. FS RR-P-1352 - Partitions, Toilet, Complete; Revision C, 1989.
- E. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; 1994e.
- F. FS RR-W-365 - Wire Fabric (Insect Screening); 1980, Rev. A (Amended 1986).
- G. FS SS-T-312 - Tile, Floor: Asphalt, Rubber, Vinyl, and Vinyl Composition; Revision B, 1974, and Amendment 1, 1979.
- H. FS TT-B-1325 - Beads (Glass Spheres); Retro-Reflective; 2007d (Validated 2017).
- I. FS TT-P-115 - Paint, Traffic (Highway, White and Yellow); Revision F, 1984.
- J. FS TT-P-1952 - Paint, Traffic Black, and Airfield Marking, Waterborne; 2015f.
- K. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).
- L. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2017h.
- M. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); 2017g.
- N. STATE STD 01.01 - Certification Standard Forced Entry and Ballistic Resistance of Structural Systems; Physical Security Division, Office of Physical Security Programs, Bureau of Diplomatic Security, United States Department of State; 1993.
- O. UFC 4-010-01 - DoD Minimum Antiterrorism Standards for Buildings; 2012.
- P. USPS Handbook AS-503 - Standard Design Criteria; United States Postal Service; 2010.

### **3.07 GSA -- U.S. GENERAL SERVICES ADMINISTRATION**

- A. GSA PBS-P100 - Facilities Standards for the Public Buildings Service; General Services Administration; 2017.

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

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

**3.09 PS -- PRODUCT STANDARDS**

- A. PS 1 - Structural Plywood; 2009.
- B. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- C. PS 20 - American Softwood Lumber Standard; 2015.

**3.10 USDA -- UNITED STATES DEPARTMENT OF AGRICULTURE**

- A. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2013.

**3.11 USGS -- UNITED STATES GEOLOGICAL SURVEY**

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

**END OF SECTION**

**SECTION 01 45 33**  
**CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Document 00 01 02 – Project Information.
- B. Section 01 33 00 – Submittal Procedures.
- C. Section 01 40 00 - Quality Requirements.
- D. Section 01 42 19 - Reference Standards.
- E. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

**1.03 DEFINITIONS**

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

**1.04 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

1. Use 2014 as indicated in 2016 CBC Referenced Standards
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
  1. Use 2010 with Supplements No. 1 and 2, excluding Chapter 14 and Appendix 11A, as indicated in 2016 CBC Referenced Standards.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
  1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- D. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.
- E. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2016.
  1. Use 2009b as indicated in 2016 CBC Referenced Standards.
- F. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- G. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2018b.
  1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- H. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
  1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2018.
  1. Use 2010 as indicated in 2016 CBC Referenced Standards.
- J. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- K. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012, with Editorial Revision (2015).
  1. Use 2012 as indicated in 2016 CBC Referenced Standards.
- L. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- M. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2018.
- N. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2015.
- O. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2018.
  1. Use 2010AE1 as indicated in 2016 CBC Referenced Standards.
- P. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a (Reapproved 2015).
- Q. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007, with Editorial Revision (2014).
  1. Use 2007 as indicated in 2016 CBC Referenced Standards

- R. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
  - 1. Use 2011 as indicated in 2016 CBC Referenced Standards
- S. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- T. NFPA 80 - Standard for Opening Protectives; 2016

**1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
  - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
  - 1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  - 2. Testing and inspections will be performed by an independent testing laboratory selected and employed by the District and approved by the Division of the State Architect (DSA).
    - a. Qualification of a testing agency or laboratory will be under the jurisdiction of the DSA Structural Safety Section (SSS). Procedural and acceptance criteria are set forth in the California Administrative Code (CBC) Chapter 4.
- D. Manufacturer's Qualification Statement: Manufacturer is required to submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.
- E. Fabricator's Qualification Statement: Fabricator is required to submit documentation of fabrication facilities and methods as well as quality control procedures. Include documentation of AHJ approval.
- F. Distribution List: The Testing Laboratory will make the following distribution of test and inspection reports:
 

1. District	1
2. Architect	2
3. Structural Engineer	1
4. Contractor	1
5. District's Inspector	1
6. Division of the State Architect	1
7. Construction Manager	1

- G. Each and every test or inspection report shall bear the File Number and Application Number assigned to this project by the DSA.
- H. DSA Form 291 shall be from the engineering manager of the laboratory of record.
- I. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one each to the distribution list.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of Special Inspector.
    - d. Date and time of special inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of special inspection.
    - h. Date of special inspection.
    - i. Results of special inspection.
    - j. Compliance with Contract Documents.
  - 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- J. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one each to the distribution list.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of Special Inspector.
    - d. Date and time of special inspection.
    - e. Identification of fabricated item and specification section.
    - f. Location in the Project.
    - g. Results of special inspection.
    - h. Verification of fabrication and quality control procedures.
    - i. Compliance with Contract Documents.
    - j. Compliance with referenced standard(s).
- K. Test Reports: After each test or inspection, promptly submit at least two copies of report; one to Architect and one each to the distribution list.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.



- f. Location in the Project.
  - g. Type of test or inspection.
  - h. Date of test or inspection.
  - i. Results of test or inspection.
  - j. Compliance with Contract Documents.
  - k. Test reports shall be signed by a Civil Engineer licensed in the State of California.
2. Test reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory.
    - a. Samples taken but not tested shall also be reported.
    - b. Records of special sampling operations as required shall also be reported.
    - c. Reports shall show that the material or materials were sampled and tested in accordance with the requirements of the CBC, and with the approved specifications.
    - d. They shall also state definitely whether or not the material or materials tested comply with requirements.
    - e. Test reports shall be issued within 14 days of finding being known, to all parties listed above.
  3. At the completion of the project, Testing Laboratory shall certify in writing and on all required DSA forms, that all work specified or required to be tested and inspected conforms to drawings, specifications and applicable building codes.
  4. Verification of Test Reports:
    - a. The Testing Laboratory of record shall submit to the Division of the State Architect (DSA) a verified report covering all tests which are required to be made by that agency during the progress of the project.
      - 1) Such report shall be furnished each time that work on the project is suspended, covering the tests up to that time, and at the completion of the project.
    - b. DSA Form 292 - Special Inspection Verified Report shall be from all special inspectors contracting directly and individually with the school board.
- L. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and AHJ.
- M. Manufacturer's Field Reports: Submit reports to Architect and AHJ.
1. Submit report in duplicate within 7 days of observation to Architect for information.
  2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.
- N. Fabricator's Field Reports: Submit reports to Architect and AHJ.
1. Submit report in duplicate within 30 days of observation to Architect for information.

2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.

#### **1.06 SPECIAL INSPECTION AGENCY**

- A. District will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with 1 and required by the building code.
- B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
- C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

#### **1.07 TESTING AND INSPECTION AGENCIES**

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

#### **1.08 QUALITY ASSURANCE**

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

#### **1.09 INSPECTION BY THE DISTRICT**

- A. The District shall have the right to reject materials and workmanship which are defective, or to require their correction.

1. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the District.
  2. If the Contractor does not correct such rejected work within a reasonable time, the District may correct such rejected work and charge the expense to the Contractor.
- B. Should it be considered necessary or advisable by the District at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out the completed work; the Contractor shall on request promptly furnish necessary facilities, labor and materials.
1. If such work is found to be defective in any respect due to fault of the Contractor or his subcontractor, he shall defray all expenses of such examinations and of satisfactory reconstruction. .
  2. If, however, such work is found to meet the requirements of the Contract, the additional cost of labor and material necessarily involved in the examination and replacement shall be allowed the Contractor.

#### **1.10 DISTRICT'S INSPECTOR**

- A. An Inspector employed by the District and approved by Architect, Structural Engineer and DSA in accordance with the requirements of the California Building Code will be assigned to the work.
1. IOR duties are specifically defined in CCR Title 24 Part 1, Sec. 4-211(b), 4-214, 4-219, and Group 1 Sec. 4-342.
- B. The District's Inspector shall at all times have access for the purpose of inspection to all parts of the work and to the shops where the work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- C. The work of construction in all stages of progress shall be subject to the personal continuous observation of the District's Inspector.
1. The Contractor shall furnish the Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials.
  2. Inspection of the work shall not relieve the Contractor from any obligation to fulfill this Contract.
  3. Inspector of Record is required to work a normal 40 hour week on this project only. Any overtime required will be at the expense of the Contractor and sub-contractor requiring the inspection.

#### **1.11 PAYMENTS**

- A. Costs of initial testing and inspection, except as specifically modified herein, or specified otherwise in technical sections, will be paid for by the District, providing such testing and inspection indicates compliance with Contract Documents. Initial tests and inspections are defined as the first tests and inspections as herein specified.
- B. In the event a test or inspection indicates failure of a material or procedure to meet requirements of Contract Documents, costs for retesting and reinspection will be paid by the District and backcharged to the Contractor.

- C. Additional tests and inspections not herein specified but requested by District or Architect, will be paid for by District, unless results of such tests and inspections are found to be not in compliance with Contract Documents, in which case the District will pay all costs for initial testing as well as retesting and reinspection and backcharge the Contractor.
- D. Costs for additional tests or inspections required because of change in materials being provided or change of source or supply will be paid by District and backcharged to the Contractor.
- E. Costs for tests or inspections which are required to correct deficiencies will be paid by the District and backcharged to the Contractor.
- F. Cost of testing which is required solely for the convenience of Contractor in his scheduling and performance of work will be paid by the District and backcharged to the Contractor.
- G. Overtime costs for testing and inspections performed outside the regular work day hours, including weekends and holidays, will be paid for by the District and backcharged to the Contractor. Such costs include overtime costs for the District's Inspector.
- H. Testing Laboratory shall separate and identify on the invoices, the costs covering all testing and inspections which are to be backcharged to the Contractor as specified above.
- I. Testing Laboratory shall furnish to District a cost estimate breakdown covering initial tests and inspections required by Contract Documents. Estimate shall include number of tests, man-hours required for tests, field and plant inspections, travel time, and costs.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL**

- A. 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.

**3.02 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.
    - a. Waiver of Batch Plant Inspection:

- 1) Batch plant inspection may be waived if the concrete plant complies fully with the requirements of CBC 1705A.3.3 subject to approval of DSA complying with either of these conditions:
    - (a) The plant must comply fully with the requirements of ASTM C94/C94M, Sections 8 and 9, and has a current certificate from the National Ready Mixed Concrete Association or another agency acceptable to the enforcement agency. The certification shall indicate that the plant has automatic batching and recording capabilities.
    - b. Prior to waiving of batch plant inspection, the testing lab must certify and submit evidence of compliance to the Architect and DSA and obtain agency approval prior to mixing concrete.
      - 1) Qualified technician of the testing laboratory shall check the first batching at the start of the day.
      - 2) Licensed weigh-master to positively identify materials as to quantity and certify to each load by a batch ticket.
      - 3) Batch tickets, including material quantities and weights shall accompany the load, shall be transmitted to the Inspector of Record by a truck driver with load identified thereon. The load shall not be placed without a batch ticket identifying the mix. The inspector will keep a daily record of placements, identifying each truck, its load and time of receipt, and approximate location of deposit in the structure and will transmit a copy of the the daily record to the enforcement agency.
- 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 District and backcharged to the Contractor.
      - 5) Samples shall include not fewer than 2 pieces, each 18 inches long, of each size and kind of reinforcing steel.
    - d. District's Inspector will inspect all reinforcement for concrete work for size, dimensions, locations and proper placement.
- C. Reinforcing Bar Welding: Verify compliance with AWS D1.4/D1.4M and ACI 318, 26.6.4; continuous.

1. Verify weldability of reinforcing bars other than those complying with ASTM A706/A706M; periodic.
  2. Inspect single-pass fillet welds, maximum 5/16 inch; periodic.
  3. Inspect all other welds; continuous.
  4. Reinforcing Bar Welding Inspection: CBC 1705A.3.1; Table 1705A.3, Item 2; 1903A.8.
- D. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved Contract Documents and ACI 318 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.
- E. Anchors Installed in Hardened Concrete: Verify compliance with ACI 318; periodic.
- F. 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.
- G. 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..
- H. Concrete and Shotcrete Placement: Verify application techniques comply with approved Contract Documents and ACI 318, Chapter 26.5; continuous.
- I. Specified Curing Temperature and Techniques: Verify compliance with 1, Chapter 26.5.3-26.5.5; continuous.
- J. Specified Curing Temperature and Techniques: Verify compliance with approved contract documents and ACI 318, Sections 5.11 through 5.13; 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. Concrete Strength in Situ: Verify concrete strength complies with approved contract documents, CBC Table 1705A.3 and ACI 318, Section 6.2, for the following.
- M. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI 318, Chapter 26.11.1.2(b); periodic.
- N. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials conform to the quality standards of ACI 318, the AHJ will require that the

Special Inspector verify compliance with the appropriate standards and criteria in ACI 318, Chapter 3. CBC 1705A3.

- O. District Inspector (IOR) will do the following:
1. Inspect placing of reinforcing steel and concrete at Project.
  2. Obtain weighmaster's certificate and identify mix before accepting each load.
  3. Keep daily record of concrete placement, identifying each truck load, time of receipt, and location of concrete in structure.
  4. Keep record until completion of Project and make available for inspection by DSA Field Engineer or representative.
  5. See also subparagraph on Waiver of 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 (38.3m<sup>3</sup>) of concrete, or not less than once for each 2,000 square feet (186 m<sup>2</sup>) 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.

### **3.03 SPECIAL INSPECTIONS FOR SOILS**

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
1. Design bearing capacity of material below shallow foundations; periodic.
  2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
  3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
  4. Subgrade, prior to placement of compacted fill verify proper preparation; periodic.
- B. Testing: Classify and test excavated material; periodic.
- C. Excavations, Foundations and Retaining Walls (Chapters 17A, 18A, and 33):

1. Earth Compaction: CBC 1705A.6; Table 1705A.6, continuous; 1804A.6.
  2. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of compacted fill: CBC 1705A.6.1; Table 1705A.6, periodic; 1804A.6.
- D. The Geotechnical Engineer of record or a Geotechnical Engineer selected by the District will provide continuous inspection of fill and will field test fill and earth backfill as placed and compacted, and inspect excavations and subgrade before concrete is placed and provide periodic inspection of open excavations, embankments, and other cuts or vertical surfaces of earth.
1. The Geotechnical Engineer will submit a Verified Report indicating observations, tested fills, and opinion the fills were placed in accordance with the project specifications.
- E. Contractor shall remove unsatisfactory material, re-roll, adjust moisture, place new material, or in the case of excavations, provide proper protective measures, perform other operations necessary, as directed by the Geotechnical Engineer whose decisions and directions will be considered final.
- F. Soils Test and Inspection Procedure:
1. Allow sufficient time for testing, and evaluation of results before material is needed. The Geotechnical Engineer shall be sole and final judge of suitability of all materials.
  2. Laboratory compaction tests to be used will be in accordance with ASTM D1557.
  3. Field density tests will be made in accordance with ASTM D1556/D1556M.
  4. Number of tests will be determined by Geotechnical Engineer. Materials in question may not be used pending test results.
  5. Excavation and embankment inspection procedure. Geotechnical Engineer will visually or otherwise examine such areas for bearing values, cleanliness and suitability.
  6. Earthwork Test Reports: In order to avoid misinterpretations by the reviewing agencies, all retest results shall be reported on the same sheet, immediately following the previous failure test to which it is related. Retests shall be clearly noted as such.

### **3.04 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.

### **3.05 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.



### **3.06 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE**

- A. 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.
- B. Mechanical and Electrical Components:
  - 1. Anchorage of electric equipment required for emergency or standby power systems; periodic.
  - 2. Installation and anchorage of other electrical equipment; periodic.
  - 3. Vibration isolation systems where the approved Contract Documents require a nominal clearance of 1/4 inch or less between support frame and seismic restraint; periodic.
- C. Structural Observations for Seismic Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

### **3.07 SPECIAL INSPECTIONS FOR WIND RESISTANCE**

- A. Structural Wood:
  - 1. Nailing, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic.
- B. Wind Resisting Components:
  - 1. Roof covering, roof deck, and floor framing connections; periodic.
  - 2. Exterior wall covering and wall connections to roof and floor diaphragms and framing; periodic.

### **3.08 SPECIAL ARCHITECTURAL INSPECTIONS**

- A. Signs and/or identification devices:
  - 1. Prior to issuance of a final Certificate of Occupancy, Enforcing Agency shall verify installation of signs for information content, appearance, location and Braille per CBC 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) 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.

### **3.09 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.

### **3.10 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES**

- A. Special Inspection Agency shall:
  - 1. Verify samples submitted by Contractor comply with the referenced standards and the approved Contract Documents.
  - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products in accordance with specified reference standards.
  - 4. Ascertain compliance of materials and products with requirements of Contract Documents.
  - 5. Promptly notify Architect, SEOR, IOR, DSA, District and Contractor of observed irregularities or non-conformance of work or products.
  - 6. Perform additional tests and inspections required by Architect.
  - 7. 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.

### **3.11 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:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  2. Agency may not approve or accept any portion of the work.
  3. Agency may not assume any duties of Contractor.
  4. Agency has no authority to stop the work.
- C. Immediately upon determination of a test failure, the Laboratory shall telephone the results to the Architect. On the same day, Laboratory shall send test results by email to the Architect and to all relevant responsible parties of the project team, and District's Inspector
- D. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.
- E. Contractor will pay for re-testing required because of non-compliance with specified requirements.
- F. At the completion of the project, Testing Laboratory shall certify in writing and on all required DSA forms, that all work specified or required to be tested and inspected conforms to drawings, specifications and applicable building codes.
1. See DSA Procedure PR 13-01.
- G. Duties of the Laboratory of Record related to the use of form DSA 152 are as follows:
1. Meet with the Project Inspector, design professionals, and contractor as needed to mutually communicate and understand the testing and inspection program and the methods of communication appropriate for the project.
  2. Obtain a copy of the DSA approved construction documents from the design professional in general responsible charge prior to the commencement of construction
  3. Obtain a copy of the DSA approved Statement of Structural Tests and Special Inspections (form DSA 103) from the design professional in general responsible charge prior to the commencement of construction.
  4. Report all project related activities to the Project Inspector. The Project Inspector is responsible for monitoring the work of the Laboratory of Record and Special Inspectors to ensure the testing and special inspection program is satisfactorily completed
  5. Provide material testing as identified in the DSA approved construction documents.

6. Submit test reports to the Project Inspector on the day the tests were performed for any tests performed on-site
  7. Submit material test reports in a timely manner such that construction is not delayed and not to exceed 14 days from the date the material tests were performed. Test reports are to be submitted to DSA, the Architect, structural engineer, Project Inspector and school district.
    - a. As a convenience, and if agreed upon by involved parties, the test reports may be submitted electronically as identified in Section 4 of this procedure.
  8. Immediately submit reports of material tests not conforming to the requirements of the DSA approved construction documents. These reports shall be submitted to the DSA, Architect, structural engineer, Project Inspector and school district.
  9. The Engineering Manager shall submit an interim Laboratory of Record Verified Report (form DSA 291) and the Geotechnical Engineer shall submit an interim Geotechnical Verified Report (form DSA 293) to DSA, the project inspector, school district and the Design Professional in General Responsible Charge.
    - a. The reports are required to be submitted upon any of the following events occurring:
      - 1) Within 14 days of the completion of the material testing/special inspection program.
      - 2) Work on the project is suspended for a period of more than one month.
      - 3) The services of the laboratory of record are terminated for any reason prior to completion of the project.
      - 4) The DSA requests a Verified Report. (See interim verified reports below. This is a "DSA request.")
  10. The Engineering Manager shall submit an interim verified report (form DSA 291) and the Geotechnical Engineer shall submit form DSA 293 to DSA and a copy to the project inspector for each of the applicable sections of the form DSA 152, prior to the project inspector signing off that section of the project inspection card, if that section required material testing. The sections are:
    - a. Initial Site Work
    - b. Foundation Prep
    - c. Vertical Framing
    - d. Horizontal Framing
    - e. Appurtenances
    - f. Finish Site Work
    - g. Other Work
    - h. Final
- H. Duties of Special Inspectors, employed by the Laboratory of Record, related to the use of form DSA 152 are as follows:
1. Meet with the Project Inspector, design professionals, and contractor as needed to mutually communicate and understand the testing and inspection program and the methods of communication appropriate for the project.

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

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

### 3.12 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 Group1, Articles 5 and 6 (Sections 4-331 through 4-344) which provide regulations governing the construction process for projects under the jurisdiction of the Division of the State Architect (DSA).
  - a. Assist the Project Inspector (IOR) and complete and fill out the following forms during the course of construction.
    - 1) Form-102-IC: Construction Start Notice/ Inspection Card Request: Verify Project Inspector has an active form issued by DSA.
    - 2) Form-151: Project Inspector Notifications: Contractor to notify IOR and assist.
    - 3) Form-152: Project Inspection Card: See below.
    - 4) Form-154: Notice of Deviations/ Resolution of Deviations: Contractor to verify all deviations are reviewed, corrected, and accepted by the design professional, and filed with DSA through the Project Inspector (IOR).
      - (a) When the Project Inspector identifies deviations from the DSA approved construction documents the inspector must verbally notify the contractor. If the deviations are not corrected within a reasonable time frame, the inspector is required to promptly issue a written notice of deviation to the contractor, with a copy sent to the design professional in general responsible charge and the DSA.
      - (b) When the noticed deviations are corrected, the inspector is required to promptly issue a written notice of resolution to the contractor, with a copy sent to the design professional in general responsible charge and the DSA.
      - (c) Deviations include both construction deviations and material deficiencies.
      - (d) The written notice of deviations shall be made using form DSA 154.
      - (e) The notice of resolution of deviations shall be made using the original form DSA 154 that reported the deviations.
    - 5) Form-156: Commencement/Completion of Work Notification
    - 6) Form-6.C: Verified Report – Contractor: From each contractor having a contract with the school board.
2. Duties of Contractor related to the use of form DSA 152 are as follows:
  - a. The Contractor shall carefully study the DSA approved documents and shall plan a schedule of operations well ahead of time.
  - b. If at any time it is discovered that work is being done which is not in accordance with the DSA approved construction documents, the Contractor shall correct the work immediately.
  - c. Verify that forms DSA 152 are issued for the project prior to the commencement of construction.
  - d. Meet with the design team, the Laboratory of Record and the Project Inspector to mutually communicate and understand the testing and inspection program and the methods of communication appropriate for the project.

- e. Notify the Project Inspector, in writing, of the commencement of construction of each and every aspect of the work at least 48 hours in advance by submitting form DSA 156 (or other agreed upon written documents) to the Project Inspector.
- f. Notify the Project Inspector of the completion of construction of each and every aspect of the work by submitting form DSA 156 (or other agreed upon written documents) to the Project Inspector.
- g. Consider the relationship of the signed off blocks and sections of the form DSA 152 and the commencement of subsequent work. Until the Project Inspector has signed off applicable blocks and sections of the form DSA 152, the Contractor may be prohibited from proceeding with subsequent construction activities that cover up the unapproved work. Any subsequent construction activities, that cover up the unapproved work, will be subject to a "Stop Work Order" from the DSA or the district and are subject to removal and remediation if found to be in non-compliance with the DSA approved construction documents.
- h. Submit the final verified report. All prime contractors are required to submit final Contractor Verified Reports (form DSA 6-C) to DSA and the project inspector.
  - 1) The reports are required to be submitted upon any of the following events occurring:
    - (a) The project is substantially complete. DSA considers the project to be complete when the construction is sufficiently complete in accordance with the DSA approved construction documents so that the owner can occupy or utilize the project.
    - (b) Work on the project is suspended for a period of more than one month.
    - (c) The services of the contractor are terminated for any reason prior to the completion of the project.
    - (d) DSA requests a verified report.

B. Contractor Responsibilities, General:

- 1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
- 2. Availability of Samples
  - a. Contractor shall make materials required for testing available to Laboratory and assist in acquiring these materials as directed by the District's Inspector. The samples shall be taken under the immediate direction and supervision of the Testing Laboratory or District's Inspector.
  - b. If work which is required to be tested or inspected is covered up without prior notice or approval, such work may be uncovered at the discretion of Architect at no additional cost to the District. Refer to paragraph "Payments" herein.
  - c. Unless otherwise specified, Contractor shall notify Testing Laboratory a minimum of 10 working days in advance of all required tests, and a minimum of 2 working days in advance of all required inspections. All extra expenses resulting from a failure to notify the Laboratory will be paid by the District and backcharged to the Contractor.
  - d. Contractor shall give sufficient advance notice to Testing Laboratory in the event of cancellation or time extension of a scheduled test or inspection. Charges due to insufficient advance, notice of cancellations, or time extension will be paid for by the District and backcharged to the Contractor.



3. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
  4. Provide incidental labor and facilities:
    - a. To provide access to work to be tested or inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
    - c. To facilitate tests or inspections.
    - d. To provide storage and curing of test samples.
  5. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
  6. Arrange with District's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  7. The Contractor shall notify the District's Inspector a minimum of 5 working days in advance of the manufacture of material to be supplied by him under the Contract Documents, which must be by terms of the Contract be tested, in order that the District may arrange for the testing of such material at the source of supply.
  8. Material shipped by the Contractor from the source of supply before having satisfactorily passed such testing and inspection or before the receipt of notice from said Inspector that such testing and inspection will not be required, shall not be incorporated in the Project.
  9. The District will select and pay testing laboratory costs for all tests and inspections, but may be reimbursed by the Contractor for such costs under the Contract conditions. Any direct payments by the Contractor to the testing laboratory on this project is prohibited.
- C. Contractor shall submit a written statement of responsibility to comply with CBC section 1704A.4.
1. Each contractor responsible for the construction of a main wind- or seismic-force-resisting system, designated seismic system or a wind- or seismic-resisting component listed in the statement of special inspections shall submit a written statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:
    - a. Acknowledgment of awareness of the special requirements contained in the statement of special inspections;
    - b. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official;
    - c. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports; and
    - d. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- D. Contractor Responsibilities, Seismic Force-Resisting System, Designated Seismic System, and Seismic Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and District prior to starting work.

Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

- E. Contractor Responsibilities, Wind Force-Resisting System and Wind Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and District prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.
- F. Unless otherwise directed, materials not conforming to the requirements of Contract Documents shall be promptly removed from the Project site.

### **3.13 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES**

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

**END OF SECTION**

**SECTION 01 50 00**  
**TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 35 53 - Security Procedures
- B. Section 01 51 00 - Temporary Utilities.
- C. Section 01 57 19 - Temporary Environmental Controls: Filtration requirements during construction and final cleaning.

**1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
  - 1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

**1.04 TEMPORARY UTILITIES - SEE SECTION 01 51 00**

- A. District will provide the following:
  - 1. Electrical power and metering, consisting of connection to existing facilities.
  - 2. Water supply, consisting of connection to existing facilities.
- B. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

**1.05 TELECOMMUNICATIONS SERVICES**

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:

## **1.06 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
  - 1. Provide temporary toilet facilities if maximum number of personnel on project is greater than 10.
  - 2. Submit proposed location of temporary toilet(s) to Construction Manager for approval.
    - a. Place on-site portable toilets away from building air intakes and entryway.
- B. Maintain daily in clean and sanitary condition.

## **1.07 BARRIERS**

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

## **1.08 FENCING**

- A. Construction: Contractor's option.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

## **1.09 EXTERIOR ENCLOSURES**

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

## **1.10 INTERIOR ENCLOSURES**

- A. Provide temporary partitions and ceilings as indicated to separate work areas from District-occupied areas, to prevent penetration of dust and moisture into District-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:
  - 1. STC rating of 35 in accordance with ASTM E90.
  - 2. Maximum flame spread rating of 75 in accordance with ASTM E84.
- C. Paint surfaces exposed to view from District-occupied areas.

## **1.11 SECURITY**

- A. Provide security and facilities to protect Work, existing facilities, and District's operations from unauthorized entry, vandalism, or theft.

- B. Coordinate with District's security program.
  - 1. Include construction surveillance camera system per the District.

#### **1.12 CAFETERIA AND FOOD**

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

#### **1.13 SMOKING AND TOBACCO**

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

#### **1.14 VEHICULAR ACCESS AND PARKING**

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and District.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

#### **1.15 WASTE REMOVAL**

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

#### **1.16 PROJECT IDENTIFICATION**

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location indicated.
- C. No other signs are allowed without District permission except those required by law.

#### **1.17 FIELD OFFICES**

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Provide separate private office similarly equipped and furnished, for use of District.
- D. Provide separate private office similarly equipped and furnished, for use of Architect and District.
- E. Locate offices a minimum distance of 30 feet from existing and new structures.

**1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

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

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 51 00**  
**TEMPORARY UTILITIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 REFERENCE STANDARDS**

- A. AHRI 560 - Voluntary Specification for Rotary Operators in Window Applications; 2010.

**1.04 TEMPORARY ELECTRICITY**

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

**1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES**

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of AHRI 560 and authorities having jurisdiction.
- B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- D. Maintain lighting and provide routine repairs.
- E. Permanent building lighting may be utilized during construction.

**1.06 TEMPORARY HEATING**

- A. Cost of Energy: By Contractor.

- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Existing facilities shall not be used.
- E. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

#### **1.07 TEMPORARY COOLING**

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Existing facilities shall not be used.

#### **1.08 TEMPORARY VENTILATION**

- A. Existing ventilation equipment may not be used.

#### **1.09 TEMPORARY WATER SERVICE**

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

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 01 52 13**  
**FIELD OFFICES AND SHEDS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 USE OF EXISTING FACILITIES**

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

**1.04 USE OF PERMANENT FACILITIES**

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

**PART 2 PRODUCTS**

**2.01 MATERIALS, EQUIPMENT, FURNISHINGS**

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

**2.02 CONSTRUCTION**

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

- G. Fire Extinguishers: Appropriate type fire extinguisher at each office.

### **2.03 ENVIRONMENTAL CONTROL**

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

### **2.04 CONTRACTOR OFFICE AND FACILITIES**

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

### **2.05 CONSTRUCTION MANAGER, DISTRICT, OWNER, PROJECT INSPECTOR, ARCHITECT, AND ENGINEER OFFICE**

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

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

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

### **3.02 INSTALLATION**

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

### **3.03 MAINTENANCE AND CLEANING**

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

### **3.04 REMOVAL**

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

**END OF SECTION**



**SECTION 01 55 00**  
**VEHICULAR ACCESS AND PARKING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: For access to site, work sequence, and occupancy.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

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

**2.02 SIGNS, SIGNALS, AND DEVICES**

- A. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.
- B. Flag Person Equipment: As required by local jurisdictions.

**PART 3 EXECUTION**

**3.01 PREPARATION**

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

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

### **3.02 ACCESS ROADS**

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

### **3.03 PARKING**

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

### **3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES**

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

### **3.05 CONSTRUCTION PARKING CONTROL**

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and District's operations.

- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

### **3.06 FLAG PERSONS**

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

### **3.07 FLARES AND LIGHTS**

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

### **3.08 HAUL ROUTES**

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

### **3.09 TRAFFIC SIGNS AND SIGNALS**

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

### **3.10 MAINTENANCE**

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

### **3.11 REMOVAL, REPAIR**

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

### **3.12 MUD FROM SITE VEHICLES**

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

**END OF SECTION**





**SECTION 01 57 13**  
**TEMPORARY EROSION AND SEDIMENT CONTROL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 SUMMARY**

- A. The District will be filing with the State of California, State Water Resources Control Board a Notice of Intent (N.O.I.) to comply with the terms of the General Permit to Discharge Storm Water Associated with Construction Activity, prior to the beginning of construction on this site.
- B. A copy of the SWPPP will be on file at the Architect's office for review by the Contractors during the bidding period. The Contractor will need to implement and monitor the storm water pollution prevention plan prepared for this site. The Contractor will be required to review the storm water pollution prevention plan and to identify possible pollution sources and mitigation measures with all subcontractors at their starting of work on site.
- C. The Contractor will be obligated to comply with the requirements of the State's General Permit. Any fines or penalties due to failure to comply with the general permit shall be borne by the Contractor.
- D. Prior to construction and after commencement of construction activities, revisions to the SWPPP shall be submitted, by the Contractor, to the Architect for amendment to the general permit by the Civil Engineer.
- E. Storm water pollution prevention plan testing and reporting will be performed by the Contractor until such responsibility is reassigned by the District.

**1.03 REFERENCE STANDARDS**

- A. California Codes and Regulations; Title 24, California Building Code, Parts 1 & 2.
- B. State of California State Water Resources Control Board Regulations.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Comply with pertinent provisions of the general permit.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

- D. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 NOT USED - REFER TO SWPP FOR MATERIALS.**

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 PREPARATION**

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

### **3.03 INSTALLATION**

- A. Installation of the work shall be as indicated on the Drawings as specified herein and regulatory requirements.
- B. Maintain the protection up to the project completion.

### **3.04 MAINTENANCE**

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

### **3.05 CLEAN UP**

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

**END OF SECTION**



**SECTION 01 57 19**  
**TEMPORARY ENVIRONMENTAL CONTROLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 PROJECT GOALS**

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

**1.03 RELATED REQUIREMENTS**

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

#### **1.04 REFERENCE STANDARDS**

- A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017.
- B. ASHRAE Std 129 - Measuring Air-Change Effectiveness; 1997 (Reaffirmed 2002).
- C. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology); 2016.
- D. ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization; 2010 (Reapproved 2018).
- E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.
- F. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.
- G. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999.
- H. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction; 2007.

#### **1.05 DEFINITIONS**

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

#### **1.06 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
  - 1. Submit not less than 60 days before enclosure of building.
  - 2. Identify potential sources of odor and dust.
  - 3. Identify construction activities likely to produce odor or dust.
  - 4. Identify areas of project potentially affected, especially occupied areas.
  - 5. Evaluate potential problems by severity and describe methods of control.
  - 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
  - 7. Describe cleaning and dust control procedures.
  - 8. Describe coordination with commissioning procedures.

- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- D. Duct and Terminal Unit Inspection Report.
- E. Air Contaminant Test Plan: Identify:
  - 1. Testing agency qualifications.
  - 2. Locations and scheduling of air sampling.
  - 3. Test procedures, in detail.
  - 4. Test instruments and apparatus.
  - 5. Sampling methods.
- F. Air Contaminant Test Reports: Show:
  - 1. Location where each sample was taken, and time.
  - 2. Test values for each air sample; average the values of each set of 3.
  - 3. HVAC operating conditions.
  - 4. Certification of test equipment calibration.
  - 5. Other conditions or discrepancies that might have influenced results.
- G. Ventilation Effectiveness Test Plan: Identify:
  - 1. Testing agency qualifications.
  - 2. Description of test spaces, including locations of air sampling.
  - 3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
  - 4. Test instruments and apparatus; identify tracer gas to be used.
  - 5. Sampling methods.
- H. Ventilation Effectiveness Test Reports: Show:
  - 1. Include preliminary tests of instruments and apparatus and of test spaces.
  - 2. Calculation of ventilation effectiveness, E.
  - 3. Location where each sample was taken, and time.
  - 4. Test values for each air sample.
  - 5. HVAC operating conditions.
  - 6. Other information specified in ASHRAE Std 129.
  - 7. Other conditions or discrepancies that might have influenced results.

## **1.07 QUALITY ASSURANCE**

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

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

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

## **PART 3 EXECUTION**

### **3.01 CONSTRUCTION PROCEDURES**

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



6. Remove intake filters last, after cleaning is complete.
- H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- I. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

### **3.02 BUILDING FLUSH-OUT**

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform building flush-out before occupancy.
- C. Do not start flush-out until:
  1. All construction is complete.
  2. HVAC systems have been tested, adjusted, and balanced for proper operation.
  3. Cleaning of inside of HVAC ductwork, specified elsewhere, has been completed.
  4. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
  5. New HVAC filtration media have been installed.
- D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
  1. Obtain District's concurrence that construction is complete enough before beginning flush-out.
  2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
  3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
  4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
    - a. Begin ventilation at least three hours prior to daily occupancy.
    - b. Continue ventilation during all occupied periods.
    - c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.
- E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

### **3.03 AIR CONTAMINANT TESTING**

- A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.
- B. Perform air contaminant testing before starting construction, as base line for evaluation of post-construction testing.
- C. Perform air contaminant testing before occupancy.
- D. Do not start air contaminant testing until:

1. All construction is complete, including interior finishes.
  2. HVAC systems have been tested, adjusted, and balanced for proper operation.
  3. Cleaning of inside of HVAC ductwork, specified elsewhere, has been completed.
  4. New HVAC filtration media have been installed.
- E. Indoor Air Samples: Collect from spaces representative of occupied areas:
1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
  2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
  3. Collect samples from height from 36 inches to 72 inches above floor.
  4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
  5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
  6. When retesting the same building areas, take samples from at least the same locations as in first test.
- F. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
- G. Analyze air samples and submit report.
- H. Air Contaminant Concentration Limits:
1. Comply with CalGreen Building Standards Section 5.504.4.5, Table 504.4.4.5 "Formaldehyde Limits".
  2. Formaldehyde: Not more than 16.3 parts per billion.
  3. PM10 Particulates: Not more than 20 micrograms per cubic meter.
  4. Comply with CalGreen Building Standards Section 5.504, Table 504.4.3 "VOC Content Limits for Architectural Coatings".
  5. Comply with CalGreen Building Standards Section 5.504, Table 504.4.1 "Adhesive VOC Limit" and Table 504.4.2 "Sealant VOC Limit".
  6. Total Volatile Organic Compounds (TVOCs): Not more than 200 micrograms per cubic meter.
  7. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
  8. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
  9. Airborne Mold and Mildew: Measure in relation to outside air; not higher than outside air.
  10. Regulated Pollutants: Measure in relation to outside air; not more than contained in outside air.

- I. Air Contaminant Concentration Test Methods:
  - 1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
  - 2. Particulates: EPA 600/4-90/010 Method IP-10.
  - 3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
  - 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
  - 5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.
- J. If air samples show concentrations higher than those specified, ventilate with 100 percent outside air and retest at no cost to District, or conduct full building flush-out specified above.

### **3.04 VENTILATION EFFECTIVENESS TESTING**

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

**END OF SECTION**



**SECTION 01 58 13**  
**TEMPORARY PROJECT SIGNAGE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: Responsibility to provide signs.
- B. Section 05 50 00 - Metal Fabrications: Miscellaneous connectors.
- C. Section 06 10 00 - Rough Carpentry: General requirements for structural and non-structural rough carpentry Work.
- D. Section 09 91 13 - Exterior Painting: General requirements for paint products and painting.

**1.03 REFERENCE STANDARDS**

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

**1.04 QUALITY ASSURANCE**

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

**1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

**PART 2 PRODUCTS**

**2.01 SIGN MATERIALS**

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

- C. Rough Hardware: Galvanized steel, as specified in Section 05 50 00 - Metal Fabrications.
- D. Sign Face Paint and Primers: Exterior quality, primer, two gloss enamel finish coats; sign background of color as selected. Provide paint type as customarily used for sign painting, adequate to resist weathering and fading for the scheduled construction period.
- E. Sign Structure Paint and Primers: Exterior quality, primer, one gloss enamel finish coats; color as selected. Provide paint type as customarily used for sign painting, adequate to resist weathering and fading for the scheduled construction period.
- F. Lettering: Exterior quality paint, colors as selected.

**2.02 PROJECT IDENTIFICATION SIGN**

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

**2.03 PROJECT INFORMATIONAL SIGNS**

- A. Restrictions: Signs other than Project Identification Sign specified above and Project Informational Signs specified below shall not be displayed without approval of Architect.
- B. Project Informational Signs: Informational signs, necessary for conduct of construction activities or required by governmental authorities having jurisdiction may be displayed when in conformance to sign construction and graphic requirements specified in this Section.
  - 1. Architect may review such signs. If so, review will be for sign construction, and graphic designs only.

2. Adequacy of signage for safety and conformance to requirements of authorities having jurisdiction and trade practices shall be solely Contractor's responsibility.
- C. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot distance.
  1. Colors shall be as required by authorities having jurisdiction and, if not otherwise required, of colors consistent with Project graphics.
  2. Informational signage shall be produced by professional sign painters and be of size and lettering style consistent with use.
- D. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.
- E. Provide municipal traffic agency directional traffic signs to and within site.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

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

### **3.02 MAINTENANCE**

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

### **3.03 REMOVAL**

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

**END OF SECTION**



**SECTION 01 60 00**  
**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: Identification of District-supplied products.
- B. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- C. Section 01 40 00 - Quality Requirements: Product quality monitoring.
- D. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- E. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.
- F. Divisions 31 – 32: Sitework.

**1.03 REFERENCE STANDARDS**

- A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - 1. Use California Electrical Code.

**1.04 SUBMITTALS**

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
  - 1. Submit within 15 days after date of Agreement.
  - 2. For products specified only by reference standards, list applicable reference standards.

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

### 1.05 QUALITY ASSURANCE

- A. CAL (CDPH SM) v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010, for the emissions testing and requirements of products and materials.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

- A. Drawings and Specifications:
  - 1. If a conflict exists between the Drawings and the Specifications (Project Manual), then the Contractor shall submit a Request for Interpretation from the Architect. See Section 01 30 00 - Administrative Requirements.
    - a. As noted in the General Conditions, the more stringent requirements shall govern, including cost of materials and/or installation.
  - 2. If a specific product is indicated on the Drawings for use, then that product shall be used without exception in the location identified.
  - 3. If the Contractor proposes the use of another product other than the item indicated, whether or not listed in these specifications, the Contractor shall submit the product using the complete substitution process. See the the Article titled "SUBSTITUTIONS".
  - 4. DSA (Division of the State Architect) approval is also required prior to the use or installation of any substitution, on any product or location of product (requiring a revision to the Drawings or Specifications), included in these construction documents.
    - a. Installation of a non-approved product may result in the Contractor removing and replacing the non-approved product at the Contractor's own expense. See Section 01 20 00 - Price and Payment Procedures.
- B. General: Items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock, and include materials, equipment, assemblies, fabrications and systems.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model designations indicated in the manufacturer's published product data.

2. **Materials:** Products that are shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed or installed to form a part of the Work.
  3. **Equipment:** A product with operating parts, whether motorized or manually operated, that requires connections such as wiring or piping.
- C. **Specific Product Requirements:** Refer to requirements of Section 01 40 00 - Quality Requirements and individual product Specifications Sections in Divisions 2 through 33 for specific requirements for products.
- D. **Minimum Requirements:** Specified requirements for products are minimum requirements. Refer to general requirements for quality of the Work specified in Section 01 40 00 - Quality Requirements and elsewhere herein.
- E. **Standard Products:**
1. Where specific products are not specified, provide standard products of types and kinds that are suitable for the intended purposes and that are usually and customarily used on similar projects under similar conditions.
  2. Products shall be as selected by Contractor and subject to review and acceptance by the District and Architect.
- F. **Product Completeness:**
1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
  2. Comply with additional requirements specified herein in Article titled "SYSTEM COMPLETENESS".
- G. **Code Compliance:**
1. All products, other than commodity products prescribed by Code, shall have a current ICC Evaluation Service Research Report (ICC ESR), CABO National Evaluation Report (NER), or other testing agencies as accepted by the Division of the State Architect.
  2. Refer to additional requirements specified in Section 01 41 00 - Regulatory Requirements.

## **2.02 SYSTEM COMPLETENESS**

- A. The Contract Drawings and Specifications are not intended to be comprehensive directions on how to produce the Work. Rather, the Drawings and Specifications are instruments of service prepared to describe the design intent for the completed Work.
- B. It is intended that all equipment, systems and assemblies be complete and fully functional even though not fully described. Provide all products and operations necessary to achieve the design intent described in the Contract Documents.
- C. Refer to related general requirements specified in Section 01 41 00 - Regulatory Requirements regarding compliance with minimum requirements of applicable codes, ordinances and standards.
- D. **Omissions and Misdescriptions:** Contractor shall report to Architect immediately when elements essential to proper execution of the Work are discovered to be missing or misdescribed in the Drawings and Specifications or if the design intent is unclear.

1. Should an essential element be discovered as missing or misdescribed prior to receipt of Bids, an Addendum will be issued so that all costs may be accounted for in the Contract Sum.
2. Should an obvious omission or misdescription of a necessary element be discovered and reported after execution of the Agreement, Contractor shall provide the element as though fully and correctly described, and a no-cost Change Order shall be executed.
3. Refer to related General Conditions or general requirements specified in Section 01 30 00 - Administrative Requirements and 01 31 14 - Facility Services Coordination regarding construction interfacing and coordination.

### **2.03 NEW PRODUCTS**

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

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

#### 2.04 PRODUCT OPTIONS

- A. Unless the specifications state that no substitution is permitted, whenever the Contract Documents indicate any specific article, device, equipment, product, material, fixture, patented process, form, method, or type of construction or any specific name, make, trade name, or catalog number, with or without the words "or equal," such specification shall be deemed to be used for the purpose of facilitating description of the material, process, or article desired and shall be deemed to be followed by the words "or equal."
1. See Section 01 25 00 - Substitution Procedures.
- B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
1. Reference Standards:
    - a. Where Specifications require compliance with a standard, provided product shall fully comply with the standard specified.
    - b. Refer to general requirements specified in Section 01 42 19 - Reference Standards regarding compliance with referenced standards, standard specifications, codes, practices and requirements for products.
  2. Product Description:
    - a. Where Specifications describe a product, listing characteristics required, with or without use of a brand name, provide a product that has the specified attributes and otherwise complies with specified requirements.
  3. Performance Requirements:
    - a. Where Specifications require compliance with performance requirements, provide product(s) that comply and are recommended by the manufacturer for the intended application.
    - b. Verification of manufacturer's recommendations may be by product literature or by certification of performance from manufacturer.

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

above in subparagraph titled "Unnamed manufacturers" and Section 01 25 00 - Substitution Procedures with the following conditions:

1. The requirements of Section 01 25 00 - Substitution Procedures shall apply to products provided under the "or equal" provision.
    - a. Exception: If the proposed product(s) are determined to be equivalent to the specified product(s) of the specified manufacturer, the requirement specified for substitutions to result in a net reduction in Contract Time or Contract Sum will be waived.
  2. Use of product(s) under the "or equal" provision shall not result in any delay in completion of the Work, including completion of portions of the Work for use by District or for work under separate contract by District.
  3. Use of product(s) under the "or equal" provision shall not result in any costs to the District, including design fees and permit and plan check fees.
  4. Use of product(s) under the "or equal" provision shall not require substantial change in the intent of the design, in the opinion of the Architect.
    - a. The intent of the design shall include functional performance and aesthetic qualities.
  5. The determination of equivalence will be made by the Architect and District, and such determination shall be final.
- G. Visual Matching:
1. Where Specifications require matching a sample, the decision by the Architect on whether a proposed product matches shall be final.
  2. Where no product visually matches but the product complies with other requirements, comply with provisions for substitutions for selection of a matching product in another category.
- H. Visual Selection of Products:
1. Where requirements include the phrase "as selected from manufacturer's standard colors, patterns and textures", or a similar phrase, selections of products will be made by indicated party or, if not indicated, by the Architect. The will select color, pattern and texture from the product line of submitted manufacturer, if all other specified provisions are met.
  2. The Architect will select color, pattern and texture from the product line of submitted manufacturer, if all other specified provisions are met.

## **2.05 MAINTENANCE MATERIALS**

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

## **PART 3 EXECUTION**

### **3.01 SUBSTITUTION LIMITATIONS**

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

### **3.02 OWNER-SUPPLIED PRODUCTS**

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

### **3.03 TRANSPORTATION AND HANDLING**

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



### 3.04 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.
  - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Inspection Provisions: Arrange storage to provide access for inspection and measurement of quantity or counting of units.
- D. Structural Considerations: Store heavy materials away from the structure in a manner that will not endanger supporting construction.
- E. Store and protect products in accordance with manufacturers' instructions.
- F. Store with seals and labels intact and legible.
- G. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- H. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- I. For exterior storage of fabricated products, place on sloped supports above ground.
  - 1. Place products on raised blocks, pallets or other supports, above ground and in a manner to not create ponding or misdirection of runoff.
- J. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- K. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
  - 1. Periodically inspect to ensure products are undamaged, and are maintained under required conditions.
  - 2. Remove and replace products damaged by improper storage or protection with new products at no change in Contract Sum or Contract Time.
  - 3. Weather-Resistant Storage:
    - a. Store moisture-sensitive products above ground, under cover in a weathertight enclosure or covered with an impervious sheet covering. Provide adequate ventilation to avoid condensation.
    - b. Maintain storage within temperature and humidity ranges required by manufacturer's instructions.
    - c. Store loose granular materials on solid surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Comply with manufacturer's warranty conditions, if any.
- M. Do not store products directly on the ground.
- N. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

- O. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- P. Prevent contact with material that may cause corrosion, discoloration, or staining.
- Q. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- R. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

### **3.05 INSTALLATION OF PRODUCTS**

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

### **3.06 PROTECTION OF COMPLETED WORK**

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

**END OF SECTION**

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

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 DEFINITIONS**

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Flooring.
  - 4. Products making up wall and ceiling assemblies.
  - 5. Thermal and acoustical insulation.
  - 6. Other products when specifically stated in the specifications.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Exterior and interior paints and coatings.
  - 2. Exterior and interior adhesives and sealants, including flooring adhesives.
  - 3. Wet-applied roofing and waterproofing.
  - 4. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
1. Concrete.
  2. Clay brick.
  3. Metals that are plated, anodized, or powder-coated.
  4. Glass.
  5. Ceramics.
  6. Solid wood flooring that is unfinished and untreated.

#### **1.04 REFERENCE STANDARDS**

- A. AHRI 340/360 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500 MM (12- to 60-in.) Diameter; 2013.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.
- D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- F. CHPS (HPPD) - High Performance Products Database; Current Edition at [www.chps.net/](http://www.chps.net/).
- G. CRI (GL) - Green Label Testing Program - Certified Products; Current Edition.
- H. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- I. GreenSeal GS-36 - Adhesives for Commercial Use; 2013.
- J. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- K. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- L. SCS (CPD) - SCS Certified Products; Current Edition.
- M. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

#### **1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.
  1. Use the form following this section for installer certifications.

- D. Verification of compliance with VOC limits as specified in the CalGreen Code Section 5.504 shall be provided at the request of the Building Inspector.
  - 1. Product certification and specifications.
  - 2. Chain of custody certifications.
  - 3. Product, labeled and invoiced as meeting the Composite Wood Products regulation.
  - 4. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards
  - 5. Other methods approved by the building official.

#### **1.06 QUALITY ASSURANCE**

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: AHRI 340/360 (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
    - c. Certification by manufacturer that product complies with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current SCS "No Added Formaldehyde (NAF)" certification; [www.scs-certified.com](http://www.scs-certified.com).
    - b. Report of laboratory testing performed in accordance with requirements.
    - c. Published product data showing compliance with requirements.
    - d. Certification by manufacturer that product complies with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

## 1.07 REGULATORY REQUIREMENTS

- A. All VOC restricted products shall be compliant with local jurisdiction, South Coast Air Quality Management District, Air Pollution Control District, County of San Diego, and California Green Standards Code, Rules and Regulations in effect at the time of installation. Products specified in this project shall be used as a basis of design. Updated products that are compliant with the rules in force at the time of installation shall be submitted as substitutions when they become available.
  - 1. If a product is found to be non-compliant with the VOC rules at the scheduled time of installation, notify the Architect a minimum of 90 days prior to installation. Contractor shall submit a suggested compliant product that is equal to the performance and cost of the specified product using the substitution procedure described in section 01 60 00 - Product Requirements.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
    - a. Comply with CalGreen Building Standards Section 5.504.4.5, Table 504.4.4.5 "Formaldehyde Limits".
  - 2. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  - 2. Aerosol Adhesives: GreenSeal GS-36.
  - 3. Joint Sealants: SCAQMD 1168 Rule.
  - 4. Paints and Coatings: Each color; most stringent of the following:
    - a. AHRI 340/360.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).
    - d. CalGreen Building Standards Section 5.504, Table 504.4.3 "VOC Content Limits for Architectural Coatings".
  - 5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.
  - 6. Clear Wood Finishes, Floor Coatings, Stains, Primers and Shellacs: Do not exceed the VOC content limits established in 1 rule.
  - 7. Carpet, Carpet Tile, and Adhesive: Provide products having VOC content not greater than that required for 1 certification.

- a. Comply with CalGreen Building Standards Section 5.504, Table 504.4.1 "Adhesive VOC Limit".
- 8. Carpet Cushion: Provide products having VOC content not greater than that required for 1 certification.
  - a. Comply with CalGreen Building Standards Section 5.504, Table 504.4.1 "Adhesive VOC Limit".
- D. Other Product Categories: Comply with limitations specified elsewhere.

### **PART 3 EXECUTION**

#### **3.01 FIELD QUALITY CONTROL**

- A. District reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to District.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION**





**SECTION 01 61 16.01**

**ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM**

**.01 FORM**

A. Identification:

1. Project Name: Imperial Valley College – Building 700 HVAC Replacement
2. Project No.: 19-43103-00
3. Architect: SGH Architects

B. Use of This Form:

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

C. VOC content restrictions are specified in Section 01 61 16.

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

**1.01 PRODUCT CERTIFICATION**

A. I certify that the installation work of my firm on this project:

1. [HAS] [HAS NOT] required the use of any ADHESIVES.
2. [HAS] [HAS NOT] required the use of any JOINT SEALANTS.
3. [HAS] [HAS NOT] required the use of any PAINTS OR COATINGS.
4. [HAS] [HAS NOT] required the use of any COMPOSITE WOOD or AGRIFIBER PRODUCTS.

B. Product data and MSDS sheets are attached.

- C. \_\_\_ Adhesives: I certify that the installation work of my firm on this project has not required the use of any adhesives.  
OR (certify either the above or the below, not both)
- D. \_\_\_ Adhesives: I certify that my firm has NOT installed any adhesive with VOC content exceeding that specified in Sections 01 60 00 and on this project; product data and MSDS sheets for all adhesives used, whether specified or not, are attached.
  
- E. \_\_\_ Joint Sealants: I certify that the installation work of my firm on this project has not required the use of any gunnable or pourable joint sealants.  
OR (certify either the above or the below, not both)
- F. \_\_\_ Joint Sealants: I certify that my firm has NOT installed any joint sealant with VOC content exceeding that specified in Section 07 92 00 - Joint Sealants on this project; product data and MSDS sheets for all joint sealants used, whether specified or not, are attached.
  
- G. \_\_\_ Coatings: I certify that the installation work of my firm on this project has not required the use of any coatings.  
OR (certify either the above or the below, not both)
- H. \_\_\_ Coatings: I certify that my firm has NOT installed any adhesive with VOC content exceeding that specified in Sections 01 60 00 and on this project; product data and MSDS sheets for all coatings used, whether specified or not, are attached.
  
- I. \_\_\_ Composite Wood and Agrifiber Products: I certify that the work of my firm on this project has not required the use of any composite wood or agrifiber products, as defined above.  
OR (certify either the above or the below, not both)
- J. \_\_\_ Composite Wood and Agrifiber Products: I certify that the composite wood and agrifiber products, as defined above, furnished or installed by my firm DO NOT contain any ADDED urea-formaldehyde binder; product data and MSDS sheets for products used, whether specified or not, are attached.

**2.01 CERTIFIED BY: (INSTALLER/MANUFACTURER/SUPPLIER FIRM)**

- A. Firm Name: \_\_\_\_\_
- B. Print Name: \_\_\_\_\_
- C. Signature: \_\_\_\_\_
- D. Title: \_\_\_\_\_ (officer of company)
- E. Date: \_\_\_\_\_

**END OF SECTION**

**SECTION 01 70 00**  
**EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 33 00 - Submittals procedures.
- C. Section 01 31 14 - Facility Services Coordination: Coordination of trades and BIM documents.
- D. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.
- E. Section 01 45 33 - Code Required Special Inspections & Procedures: Construction oversight procedures by DSA regarding the execution, approval, and closeout of this building project.
- F. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.
- G. Section 01 50 00 - Temporary Facilities and Controls: Temporary interior partitions.
- H. Section 01 74 19 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- I. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- J. Section 01 79 00 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- K. Section 02 41 00 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.
- L. Section 02 84 00 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to PCB- and mercury-containing equipment.

- M. Section 07 84 00 - Firestopping.
- N. Individual Product Specification Sections:
  - 1. Advance notification to other sections of openings required in work of those sections.
  - 2. Limitations on cutting structural members.

### **1.03 REFERENCE STANDARDS**

- A. CFC Ch. 35 - California Fire Code - Chapter 35 - Welding and Other Hot Work; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of District or separate Contractor.
  - 6. Include in request:
    - a. Identification of Project.
    - b. Location and description of affected work. Include shop drawings as necessary to identify locations and communicate descriptions.
    - c. Necessity for cutting or alteration.
    - d. Description of proposed work and products to be used.
    - e. Effect on work of District or separate Contractor.
    - f. Effect on existing construction of District and, if applicable, work for Project being provided by District under separate contract.
    - g. Written permission of affected separate Contractor.
    - h. Date and time work will be executed.
  - 7. Include written evidence that those performing work under separate contract for District have been notified and acknowledge that cutting and patching work will be occurring. Include written permission for intended cutting and patching, included scheduled times.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

## 1.05 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
  - 1. Minimum of 5 years of documented experience.
- B. For surveying work, employ a land surveyor registered in California and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,
- C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in California. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.
- D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in California.

## 1.06 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
  - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  - 1. Minimize amount of bare soil exposed at one time.
  - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
  - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
  - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
  - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.
  - 2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

- H. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

## **1.07 COORDINATION**

- A. See Section 01 10 00 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After District occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of District's activities.

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

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

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.
- D. Temporary Supports: Provide supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- E. Weather Protection: Provide protection from elements for areas which may be exposed by uncovering Work. Maintain excavations free of water.

### **3.03 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
  - 1. Coordinate operations of the various trades to assure efficient and orderly installation of each part of Work.
  - 2. Coordinate Work operations of the various trades that depend on each other for proper installation, connection, and operation of Work, including but not limited to:
    - a. Schedule construction operations in sequence required where installation of one part of Work depends on installation of other components, before or after its own installation.
    - b. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
    - c. Provide provisions to accommodate items scheduled for later installation.
  - 3. Prepare and administer coordination drawings. Refer to Section 01 31 14 - Facility Services Coordination.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.

### 3.04 LAYING OUT THE WORK

- A. Notify the District at least 48 hours before staking is to be started.
- B. Verify locations of survey control points prior to starting work.
- C. Promptly notify Architect of any discrepancies discovered.
- D. Contractor shall locate and protect survey control and reference points.
- E. Control datum for survey is that established by District provided survey.
- F. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- G. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- H. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- I. Utilize recognized engineering survey practices.
- J. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- K. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations.
- L. Periodically verify layouts by same means.
- M. Maintain a complete and accurate log of control and survey work as it progresses.
- N. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

### 3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Dimensions for Accessibility:
  - 1. Conventions: See CBC Figure 11B-104. Dimensions that are not stated as "maximum" or "minimum" are absolute.
  - 2. Tolerances shall be per CBC 11B-104.1.1 "Construction and manufacturing tolerances. All dimensions are subject to conventional industry tolerances except where the requirement is stated as a range with specific minimum and maximum end points."
- B. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- C. When welding or doing other hot work, comply with CFC Ch. 35.
- D. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.



- E. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- F. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- G. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- H. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.06 ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 .
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
  - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
  - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
  - 2. Remove items indicated on drawings.
  - 3. Relocate items indicated on drawings.
  - 4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.

3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. Provide temporary connections as required to maintain existing systems in service.
  4. Verify that abandoned services serve only abandoned facilities.
  5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
  2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
  3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
  4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
  2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

### 3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  - 1. Complete the work.
  - 2. Fit products together to integrate with other work.
  - 3. Provide openings for penetration of mechanical, electrical, and other services.
  - 4. Match work that has been cut to adjacent work.
  - 5. Repair areas adjacent to cuts to required condition.
  - 6. Repair new work damaged by subsequent work.
  - 7. Remove samples of installed work for testing when requested.
  - 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
  - 1. Coordinate installation or application of products for integrated Work.
  - 2. Uncover completed Work as necessary to install or apply products out of sequence.
  - 3. Remove and replace defective or non-conforming Work.
  - 4. Provide openings for penetration of utility services, such as plumbing, mechanical and electrical Work.
- E. After uncovering existing Work, inspect conditions affecting proper accomplishment of Work.
- F. Temporary Supports: Provide supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- G. Beginning of cutting or patching shall be interpreted to mean that existing conditions were found by Contractor to be acceptable.
- H. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- I. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
  - 1. Use a diamond grit abrasive saw or similar cutter for smooth edges. Do not overcut corners.
- J. Restore work with new products in accordance with requirements of Contract Documents.
- K. Fit work neat and tight allowing for expansion and contraction.
- L. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- M. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- N. Patching:

1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  2. Match color, texture, and appearance.
  3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- O. Finishing: Refinish surfaces to match adjacent and similar finishes as used for the Project.
1. For continuous surfaces, refinish to nearest intersection or natural break.
  2. For an assembly, refinish entire unit.

### **3.08 PROGRESS CLEANING**

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

### **3.09 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.10 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.11 PROJECT CLOSEOUT CONFERENCE**

- A. Schedule and conduct a project closeout conference, at a time convenient to District and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
  - 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: Authorized representatives of District, Commissioning Authority (CxA), Architect, and relevant consultants; Contractor and project superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Commissioning.
    - c. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - d. Submittal of written warranties.
    - e. Coordination of separate contracts.
    - f. District's partial occupancy requirements.
    - g. Installation of District's furniture, fixtures, and equipment.
    - h. Responsibility for removing temporary facilities and controls.
  - 4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.

### **3.12 DEMONSTRATION AND INSTRUCTION**

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

### **3.13 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

### **3.14 FINAL CLEANING**

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

### **3.15 CLOSEOUT PROCEDURES**

- A. Clean-Up Retainage:
  - 1. Five (5) percent of each Contractor's bid will automatically be held in abeyance in their contract schedule of values for clean-up.

2. If in the Construction Manager's opinion the Contractor is maintaining a clean project, a pro-rata share of this clean-up budget will be paid monthly to the Contractor in accordance with their approximate aggregate percentage of completion of the project.
  3. If a Contractor fails to heed written directives to clean-up during the course of the project, the work will be done at the Contractor's expense and a deductive change order will be written against their contract with the District.
  4. The establishment of this 5 percent budget in no way limits the cost for the Contractor to maintain a clean project.
- B. Make submittals that are required by governing or other authorities.
1. Provide copies to Architect and District.
- C. Accompany Architect, Construction Manager, and District Representative on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's comprehensive list of items to be completed or corrected.
1. As authorized by the District; Architect and Architect's and District's consultants, as appropriate, will attend a meeting at the Project site to review Contract closeout procedures and to review the list of items to be completed and corrected (punch list) to make the Work ready for acceptance by the District.
  2. This meeting shall be scheduled not earlier than 14 days prior to the date anticipated for the Substantial Completion review.
- D. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- E. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
1. Final Application for Payment: In the Application for Payment that coincides with the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed substantially complete.
  2. Warranties, Bonds and Certificates: Submit specific warranties, guarantees, workmanship bonds, maintenance agreements, final certifications and similar documents.
  3. Locks and Keys: Change temporary lock cylinders over to permanent keying and transmit keys to the District, unless otherwise directed or specified.
  4. Tests and Instructions: Complete start-up testing of systems, and instruction of the District's personnel. Remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- F. Clearing and Cleaning: Prior to the Substantial Completion review, Contractor shall conduct a thorough cleaning and clearing of the Project area, including removal of construction facilities and temporary controls.

- G. Inspection and Testing: Prior to the Substantial Completion review, complete inspection and testing required for the Work, including securing of approvals by authorities having jurisdiction.
1. Complete all inspections, tests, balancing, sterilization and cleaning of plumbing and HVAC systems.
  2. Complete inspections and tests of electrical power and signal systems.
  3. Complete inspections and tests of conveying (elevator or wheelchair lift) systems.
- H. District will occupy all of the building as specified in Section 01 10 00.
- I. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
1. Correction (Punch) List: Contractor shall prepare and distribute at the preliminary Contract closeout review meeting, a typewritten, comprehensive list of items to be completed and corrected (punch list) to make the Work ready for acceptance by the District.
    - a. The punch list shall include all items to be completed or corrected prior to the Contractor's application for final payment.
    - b. The punch list shall identify items by location (room number or name) and consecutive number. For example, 307-5 would identify item 5 in Room 307, Roof-4 would identify item 4 on Roof.
    - c. Contractor shall prepare separate lists according to categories used for Drawings. For example, provide lists for Architectural, Structural, Plumbing, Mechanical, Electrical, Fire Protection, Civil, and Landscape.
    - d. Architect, Architect's consultants and District's consultants, if in attendance, will conduct a brief walk-through of Project with the Contractor to review scope and adequacy of the punch list.
    - e. Verbal comments will be made to the Contractor by the Construction Manager, the Architect and the Architect's and District's consultants, if in attendance, during the walk-through. These comments will indicate generally the additions and corrections to be made to the punch list. Such comments shall not be considered to be comprehensive; Contractor shall use the comments as guidance in preparing the punch list for the Substantial Completion review.
  2. Substantial Completion Meeting: On a date mutually agreed by the District, Architect, and Contractor, a meeting shall be conducted at the Project site to determine whether the Work is satisfactory and complete for filing a Notice of Completion (Substantial Completion).
    - a. Contractor shall provide three working days notice to Architect for requested date of Substantial Completion meeting.
    - b. The Construction Manager, the Architect and the Architect's and District's consultants, as authorized by the District, will attend the Substantial Completion meeting.
    - c. In addition to conducting a walk-through of the facility and reviewing the punch list, the purpose of the meeting shall include submission of warranties, guarantees and bonds to the District, submission of operation and maintenance data (manuals),



- provision of specified extra materials to the District, and submission of other Contract closeout documents and materials as required and if not already submitted.
- d. The Construction Manager, the Architect and Architect's consultants, as appropriate, will conduct a walk-through of the facility with the Contractor and review the punch list.
  - e. Contractor shall correct the punch list and record additional items as may identified during the walk-through, including notations of corrective actions to be taken.
  - f. Contractor shall retype the punch list and distribute it within three working days to those attending the meeting.
  - g. If additional site visits by the Construction Manager, the Architect and the Architect's and District's consultants are required to review completion and correction of the Work, the costs of additional visits shall be reimbursed to the District by the Contractor by deducting such costs from the Final Payment.
- J. Correct items of work listed in Final Correction Punch List and comply with requirements for access to District-occupied areas.
  - K. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
    - 1. Architect's Certification of Substantial Completion:
      - a. When Architect determines that list of items to be completed and corrected (Punch List) is sufficiently complete for District to occupy Project for the use to which it is intended.
      - b. Architect will complete and issue to the District and Contractor a Certificate of Substantial Completion using:
        - 1) The American Institute of Architects Form G704 - Certificate of Substantial Completion
        - 2) or other form if directed by the District.
  - L. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

### **3.16 FINAL PAYMENT**

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

### **3.17 MAINTENANCE**

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

**END OF SECTION**

**SECTION 01 71 23**  
**FIELD ENGINEERING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Field engineering services by Contractor.
- B. Land surveying services by Contractor.

**1.02 DESCRIPTION OF SERVICES**

- A. Specific services listed in this section are in addition to, and do not supersede, general Execution and Closeout Requirements.
- B. Sole responsibility for establishing all locations, dimensions and levels of items of work.
- C. Sole responsibility for provision of all materials required to establish and maintain benchmarks and control points, including batter boards, grade stakes, structure elevation stakes, and other items.
- D. Having a skilled instrument person(s) available on short notice when necessary for laying out the work.
- E. Keeping a transit, theodolite, or TST (total station theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the project site at all times.
- F. Provision of facilities and assistance necessary for Architect to check lines and grade points placed by Contractor.
  - 1. Performance of excavation or embankment work until after all cross-sectioning necessary for determining payment quantities for Unit Price work have been completed and accepted by Architect.
- G. Preparation and maintenance of daily reports of activity on the work. Submission of reports containing key progress indicators and job conditions to Architect.
  - 1. Number of employees at the Site.
  - 2. Number employees at the Site for each of Contractor's subcontractors.
  - 3. Breakdown of employees by trades.
  - 4. Major equipment and materials installed as part of the work.
  - 5. Major construction equipment utilized.
  - 6. Location of areas in which construction was performed.
  - 7. Materials and equipment received.
  - 8. Work performed, including field quality control measures and testing.
  - 9. Weather conditions.
  - 10. Safety.
  - 11. Delays encountered, amount of delay incurred, and the reasons for the delay.

- 12. Instructions received from Architect or District, if any.
- H. Preparation and maintenance of professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the work.
- I. Prior to backfilling operations, surveying - locating, and recording on a copy of Contract Documents - an accurate representation of buried work and Underground Facilities encountered.
- J. Setting up and executing time-lapse photography of construction activities.

### **1.03 REFERENCE STANDARDS**

- A. FGDC-STD-007.1 - Geospatial Positioning Accuracy Standards - Part 1: Reporting Methodology; 1998.
- B. FGDC-STD-007.2 - Geospatial Positioning Accuracy Standards - Part 2: Standards for Geodetic Networks; 1998.
- C. FGDC-STD-007.4 - Geospatial Positioning Accuracy Standards - Part 4: Architecture, Engineering, Construction, and Facilities Measurement; 2002.
- D. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- E. State Plane Coordinate System for California.

### **1.04 ADMINISTRATIVE REQUIREMENTS**

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

### **1.05 SUBMITTALS**

- A. See Section 01 33 00 - Submittal Procedures.
- B. Submit in addition to items required in Section 01 70 00 - Execution and Closeout Requirements.
- C. Informational Submittals: Submit the following:
  - 1. Field Engineering: Submit daily reports, with content as indicated in this section.
    - a. When requested by Architect, submit for Record documentation verifying accuracy of field engineering including, but not limited to, Contractor's survey notes and field notes.
  - 2. Final property survey.

### **1.06 QUALITY ASSURANCE**

- A. Field Engineer's Qualifications: As established in Section 01 70 00 - Execution and Closeout Requirements.
- B. Land Surveyor's Qualifications: As established in Section 01 70 00 - Execution and Closeout Requirements.
- C. Use adequate number of skilled and thoroughly-trained workers to perform the work of this section in a timely and comprehensive manner.
- D. Minimum accuracy for required work is as follows:

1. Grade: Horizontal Tolerance: Plus or minus 0.5 feet, Vertical Tolerance: Plus or minus 0.05 feet.
2. Culverts and ditches: Horizontal Tolerance: Plus or minus 0.5 feet, Vertical Tolerance: Plus or minus 0.05 feet.
3. Structures: Horizontal Tolerance: Plus or minus 0.5 feet (location), Vertical Tolerance: Plus or minus 0.05 feet.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. Notify District's Representative and Architect of any discrepancies immediately in writing before proceeding to lay out the work. Locate and protect existing benchmarks and base line. Preserve permanent reference points during construction.
- B. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify existing conditions.

### **3.02 FIELD ENGINEERING**

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

### 3.03 LAND SURVEYING

- A. General: Follow standards for geospatial positioning accuracy.
  - 1. FGDC-STD-007.1 as amended by Authority Having Jurisdiction.
  - 2. FGDC-STD-007.2 as amended by Authority Having Jurisdiction.
  - 3. FGDC-STD-007.4 as amended by Authority Having Jurisdiction.
- B. Coordinate survey data with the State Plane Coordinate System of California.
- C. Contractor is responsible for the restoration of all property corners and control monuments damaged or destroyed by construction-related activities. Any disturbed monuments must be replaced at Contractor's expense by a surveyor licensed in California, and approved by the Architect.
  - 1. Temporarily suspend work at such points and for such reasonable times as the District may require for resetting monuments. The Contractor will not be entitled to any additional compensation or extension of time.

### 3.04 CONSTRUCTION SURVEYING

- A. General: Perform surveying as applicable to specific items necessary for proper execution of work.
  - 1. Alignment Staking: Provide alignment stakes at 50 foot intervals on tangent, and at 25 foot intervals on curves.
  - 2. Slope Staking: Provide slope staking at 50 foot intervals on tangent, and at 25 foot intervals on curves. Re-stake at every ten-foot difference in elevation.
  - 3. Structure: Stake out structures, including elevations, and check prior to and during construction.
  - 4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.
  - 5. Site Utilities: Stake out utility lines including elevations, and check prior to and during construction.
  - 6. Road: Stake out roadway elevations at 50 foot intervals on tangent, and at 25 foot intervals on curves.
  - 7. Cross-sections: Provide original, intermediate, and final staking as required, for site work and other locations as necessary for quantity surveys.
  - 8. Easement Staking: Provide easement staking at 50 foot intervals on tangent, and at 25 foot intervals on curves. If required by project conditions, provide wooden laths with flagging at 100 foot intervals.
  - 9. Record Staking: Provide permanent stake at each blind flange and each utility cap is provided for future connections. Use stakes for record staking of material(s) acceptable to Architect.
  - 10. Structural Frame: Upon completion, certify location and plumbness.
- B. Surveying to Determine Quantities for Payment.

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

### **3.05 SUPPORT AND BRACING**

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

### **3.06 TIME-LAPSE PHOTOGRAPHY**

- A. Provide as part of Construction Progress documentation.
- B. Set a pole at appropriate location(s), and provide a time-lapse camera to record the entire construction project. Camera (or cameras) is required to provide a field of view of the entire project area.

- C. Provide a camera that records at one frame per second rate, or as approved by Architect. Resulting time-lapse will be viewed at standard 25 frames-per-second speed.
  - 1. Program camera, or provide a timer-controller, to only record during construction work hours.
- D. Submit to the District and Architect a DVD containing the raw video on a weekly basis. Submit entire digital time-lapse photography record at the conclusion of the project.

### **3.07 REPORTS**

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

### **3.08 RECORDS**

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

### **3.09 CLOSEOUT ACTIVITIES**

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

**END OF SECTION**



**SECTION 01 74 19**  
**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

**PART 1 GENERAL**

**1.01 WASTE MANAGEMENT REQUIREMENTS**

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

13. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (<http://flooring.dupont.com>) and Interface ([www.interfaceinc.com](http://www.interfaceinc.com)) conduct reclamation programs.
  14. Roofing.
  15. Paint.
  16. Plastic sheeting.
  17. Rigid foam insulation.
  18. Windows, doors, and door hardware.
  19. Plumbing fixtures.
  20. Mechanical and electrical equipment.
  21. Fluorescent lamps (light bulbs).
  22. Acoustical ceiling tile and panels.
  23. Materials which could be hazardous and subject to special disposal regulations include but are not limited to the following: CalGreen Section 5.408.2
    - a. Lead-Based Paint
    - b. Asbestos: Found in older pipe insulation, asphalt floor tiles, linoleum, insulation, etc.
    - c. Polychlorinated Biphenyls (PCBs):
      - 1) Found in electrical oil filled equipment manufactured prior to 1978 such as transformers, switches and fluorescent lamp ballasts.
      - 2) Also found in adhesive, sealant, caulk, glazing putty, roofing material, pesticide vehicle, ink, paper, fabric dye, gaskets, and hydraulic fluid.
    - d. HVAC Refrigerants: Containing Fluorinated and Chlorinated compounds.
    - e. Drinking Fountain Refrigerants: Containing Fluorinated and Chlorinated compounds.
    - f. Fluorescent Light Tubes: Contain mercury.
    - g. EXIT signs and Smoke Detectors: May contain unregulated, radioactive tritium. Required to be returned to manufacturer.
    - h. Contaminated Soils.
    - i. Pressure Treated Lumber.
- F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
1. Contractor's quantitative reports for construction waste materials as a condition of approval of progress payments.
- G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements. CalGreen Section 5.408.1.1.
- H. The following sources may be useful in developing the Waste Management Plan:
1. California Recycling Department, at [www.bsc.ca.gov/Home/CALGreen.aspx](http://www.bsc.ca.gov/Home/CALGreen.aspx).
  2. General information contacts regarding construction and demolition waste:
    - a. EPA Construction and demolition (C&D) debris website: [www.epa.gov/epawaste/conserves/imr/cdm/](http://www.epa.gov/epawaste/conserves/imr/cdm/).

- b. Directory of Wood-Framed Building Deconstruction and Reused Building Materials Companies: [www.fpl.fs.fed.us/documnts/fplgtr/fpl\\_gtr150.pdf](http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr150.pdf).
  - c. Additional resources to be developed by Contractor with assistance from District and Contractor, as requested.
3. Recycling Haulers and Markets: The source list below contains local haulers and markets for recyclable materials. This list is provided for information only and is not necessarily comprehensive; other haulers and markets are acceptable.
- a. CAL-MAX: [www.calrecycle.ca.gov/calmax/](http://www.calrecycle.ca.gov/calmax/).
    - 1) A free service designed to help businesses find markets for non-hazardous materials they have traditionally discarded.
  - b. General Recycling/Reuse Centers: For information on qualified local solid waste haulers contact the California Department of Resources Recycling and Recovery - CalRecycle. The website lists wastes recycling facilities in counties throughout the State of California.
    - 1) <http://www.calrecycle.ca.gov/default.asp>
- I. Methods of trash/waste disposal that are not acceptable are:
- 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
  - 5. Incineration, either on- or off-site.
- J. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

## 1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 01 50 00 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 01 60 00 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- D. Section 01 70 00 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

## 1.03 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
  - 1. Debris that is not hazardous as defined in CalGreen Section 5.408.2 and California Code of Regulations, Title 22, Section 66261.3 et seq.

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

- P. Recycling Center: A facility that receives only C&D material that has been separated for reuse prior to receipt, in which the residual (disposed) amount of waste in the material is less than 10% of the amount separated for reuse by weight.
- Q. Return: To give back reusable items or unused products to vendors for credit.
- R. Reuse: To reuse a construction waste material in some manner on the project site.
- S. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- T. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- U. Separated for Reuse:
  - 1. Materials, including commingled recyclables.
  - 2. Separated or kept separate from the solid waste stream for the purpose of:
    - a. Additional sorting or processing those materials for reuse or recycling.
      - 1) In order to return them to the economic mainstream in the form of raw material for new, reused, or reconstituted products.
    - b. Products shall meet the quality standards necessary to be used in the marketplace.
    - c. Includes materials that have been "source separated".
- V. Solid Waste:
  - 1. All putrescible and nonputrescible solid, semisolid, and liquid wastes, including:
    - a. Garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes.
    - b. Abandoned vehicles and parts thereof.
    - c. Discarded home and industrial appliances.
    - d. Dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste.
    - e. Manure, vegetable or animal solid and semisolid wastes.
    - f. Other discarded solid and semisolid wastes.
  - 2. "Solid waste" does not include hazardous waste, radioactive waste, or medical waste as defined or regulated by State law.
- W. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
  - 1. Materials, including commingled recyclables, that have been separated or kept separate from the solid waste stream at the point of generation, for the purpose of additional sorting or processing of those materials for reuse or recycling in order to return them to the economic mainstream in the form of raw materials for new, reused, or reconstituted products which meet the quality standards necessary to be used in the marketplace.
- X. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- Y. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- Z. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

- AA. Waste Hauler: A company that possesses a valid permit from the local waste management authority to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal in the locality.

#### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Submit Waste Management Plan within 30 calendar days after receipt of Notice to Proceed, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
  - 1. Submit four copies of CWMP for review.
    - a. Contractor's Construction Waste and Recycling Plan must be approved by the Architect and Construction Manager prior to the start of Work.
  - 2. Approval of the Contractor's CWMP shall not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
- C. Waste Management Plan: Include the following information:
  - 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
  - 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
  - 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
    - a. List each material proposed to be salvaged, reused, or recycled.
    - b. List the local market for each material.
  - 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
  - 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
  - 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
  - 7. Recycling Incentives: Describe procedures required to obtain credits, rebates, or similar incentives.
- D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
  - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
    - a. Inert materials shall achieve a construction waste diversion rate of at least 95 percent.

- 1) These materials include, but are not limited to, concrete, asphalt and rock.
  - 2) Earthwork is not included.
  - 3) Excavated soil shall not be included in any of the calculations used to ensure compliance with this specification section.
- b. The overall diversion rate must be based on weight.
  - c. The diversion rate of individual materials can be measured in either weight or volume, but the rate shall be converted into the units selected for calculating the overall diversion rate.
    - 1) All individual material diversions must be converted to a consistent set of units when calculating the overall diversion rate for the all reports and submittals required for the Work.
  - d. Conversion rate numbers shall be based on standard conversion rate data for construction projects provided by the California Integrated Waste Management Board (CIWMB). This data is available at the following internet location, <http://www.calrecycle.ca.gov/LGCentral/Library/dsg/ICandD.htm>.
2. Submit Report on a form acceptable to District.
  3. Landfill Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
    - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  4. Recycled and Salvaged Materials: Include the following information for each:
    - a. Identification of material, including those retrieved by installer for use on other projects.
    - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
  5. Material Reused on Project: Include the following information for each:
    - a. Identification of material and how it was used in the project.
    - b. Amount, in tons or cubic yards.
    - c. Include weight tickets as evidence of quantity.
  6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT SUBSTITUTIONS**

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

## **PART 3 EXECUTION**

### **3.01 WASTE MANAGEMENT PROCEDURES**

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

### **3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION**

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



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

### **3.03 DISPOSAL OPERATIONS AND WASTE HAULING**

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

### **3.04 PLAN AND REPORT FORMS**

- A. See suggested forms on the following pages.

**END OF SECTION**

## CONTRACTOR'S CONSTRUCTION WASTE AND RECYCLING PLAN

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

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

**CONTRACTOR'S CONSTRUCTION WASTE AND RECYCLING PLAN**

Continued

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

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

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

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

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

- Notes:
- |  |  |
|--|--|
| 1. Suggested Conversion Factors: From Cubic Yards to Tons<br>(Use when scales are not available) | c. Ferrous Metals: .22 (ex. 1000 CY Ferrous Metal = 220 tons)          |
| a. Asphalt: .61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)            | d. Non-Ferrous Metals: .10 (ex. 1000 CY Non-Ferrous Metals = 100 tons) |
| b. Concrete: .93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)         | e. Drywall Scrap: .20  |
|  | f. Wood Scrap: .16   |

## CONTRACTOR'S REUSE, RECYCLING, AND DISPOSAL REPORT

(Submit With Each Progress Payment)

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

## CONTRACTOR'S REUSE, RECYCLING, AND DISPOSAL REPORT

Continued

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

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

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

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

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

- Notes:
- |  |  |
|--|--|
| <p>1. Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)</p> <ul style="list-style-type: none"> <li>a. Asphalt: .61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)</li> <li>b. Concrete: .93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)</li> </ul> | <ul style="list-style-type: none"> <li>c. Ferrous Metals: .22 (ex. 1000 CY Ferrous Metal = 220 tons)</li> <li>d. Non-Ferrous Metals: .10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)</li> <li>e. Drywall Scrap: .20</li> <li>f. Wood Scrap: .16</li> </ul> |
|--|--|

**SECTION 01 76 10**  
**TEMPORARY PROTECTIVE COVERINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

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

**1.03 REFERENCE STANDARDS**

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- B. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2017).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- E. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes available; and installation instructions.
- C. Shop Drawings: Indicate existing finished surfaces to be protected.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

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

**2.02 GENERAL**

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

3. Impact resistant.
4. Slip resistant.
5. Flame retardant.

## **2.03 MATERIALS**

### **A. Sheet Materials:**

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

### **B. Rolled Materials:**

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

### **C. Corner and Door Jamb Protection Materials:**

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

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

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

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

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Trim or overlap sheet materials to fit area to be covered.



- C. Roll out and cut rolled materials to fit area to be covered.
- D. Tape seams. Avoid taping directly to finished surfaces.
- E. Stretch self-adhering film materials to completely cover surface.
- F. Install door jamb protection to full height of opening.
- G. Position corner protection 4 inches above finished floor to 96 inches high.

### **3.03 REMOVAL**

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

**END OF SECTION**



**SECTION 01 78 00**  
**CLOSEOUT SUBMITTALS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

**1.02 RELATED REQUIREMENTS**

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

**1.03 DEFINITIONS**

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

#### 1.04 SUBMITTALS

- A. Advance Submittals: For equipment and systems, or component parts of systems, put into service during construction and operated by District, submit documents within ten days of start of operation by District.
- B. Final Completion Submittals: Prior to application for final payment, Contractor shall submit 3 copies the following:
  - 1. Agency Document Submittals: Submit to District all documents required by authorities having jurisdiction, including serving utilities and other agencies. Submit original versions of all permit cards, with final sign-off by inspectors. Submit all certifications of inspections and tests.
    - a. Contractor shall also complete all required contractor forms and obtain DSA approval of these same forms. Comply with "Final Certification of Construction" per Title 24 Part 1 section 4-339.
      - 1) Form-6.C: Verified Report – Contractor: From each Contractor having a contract with the District.
  - 2. Final Specifications Submittals: Submit to District all documents and products required by Specifications to be submitted, including the following:
    - a. Project record drawings and specifications.
    - b. Operating and maintenance data.
    - c. Guarantees, warranties and bonds.
    - d. Spare parts and extra stock.
    - e. Test reports and certificates of compliance.
  - 3. Certificates of Compliance and Test Report Submittals: Submit to District certificates and reports as specified and as required by authorities having jurisdiction, including the following:
    - a. Sterilization of water systems.
    - b. Gas system tests.
    - c. Lighting, power and signal system tests.
    - d. Ventilation equipment and air balance tests.
    - e. Roofing inspections and tests.
  - 4. Lien and Bonding Company Releases: Submit to District, with copy to Architect, evidence of satisfaction of encumbrances on Project by completion and submission of The American Institute of Architects Forms:
    - a. G706 - Contractor's Affidavit of Payment of Debts and Claims;
    - b. G706A - Contractor's Affidavit of Release of Liens;
    - c. (if applicable) G707 - Consent of Surety;
    - d. or forms as as agreed to by the District.
    - e. Comply also with other requirements of District, as directed.
    - f. All signatures shall be notarized.
  - 5. Subcontractor List: Submit to two copies to District and two copies to Architect of updated Subcontractor and Materials Supplier List.

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

## **1.05 WARRANTIES AND GUARANTEES**

- A. General:
  1. Provide all warranties and guarantees with District named as beneficiary.
  2. For equipment and products, or components thereof, bearing a manufacturer's warranty or guarantee that extends for a period of time beyond the Contractor's warranty and guarantee, so state in the warranty or guarantee.
- B. Provisions for Special Warranties: Refer to Conditions of the Contract for terms of the Contractor's special warranty of workmanship and materials.
- C. General Warranty and Guarantee Requirements:
  1. Warranty shall be an agreement to repair or replace, without cost and undue hardship to District, Work performed under the Contract which is found to be defective during the Correction Period (warranty or guarantee) period.
  2. Repairs and replacements due to improper maintenance or operation, or due to normal wear, usage and weathering are excluded from warranty requirements unless otherwise specified.
- D. Specific Warranty and Guarantee Requirements: Specific requirements are included in product Specifications Sections of Divisions 3 through 32, including content and limitations.
- E. Disclaimers and Limitations:

1. Manufacturer's disclaimers and limitations on product warranties and guarantees shall not relieve Contractor of responsibility for warranty and guarantee requirements.
  2. This applies to the Work that incorporates such products, nor shall they relieve suppliers, manufacturers, and installers required to countersign special warranties with Contractor.
- F. Related Damages and Losses: When correcting warranted Work that has been found defective, remove and replace other Work that has been damaged as a result of such defect or that must be removed and replaced to provide access for correction of warranted Work.
- G. Reinstatement of Warranty:
1. When Work covered by a warranty has been found defective and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
  2. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- H. Replacement Cost:
1. Upon determination that Work covered by a warranty has been found to be defective, replace or reconstruct the Work to a condition acceptable to District, complying with applicable requirements of the Contract Documents.
  2. Contractor shall be responsible for all costs for replacing or reconstructing defective Work regardless of whether District has benefited from use of the Work through a portion of its anticipated useful service life.
- I. District's Recourse:
1. Written warranties made to the District shall be in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under law, nor shall warranty periods be interpreted as limitations on time in which the District can enforce such other duties, obligations, rights, or remedies.
  2. Rejection of Warranties:
    - a. The District reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- J. Warranty as Condition of Acceptance:
1. District reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment shall be required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 PROJECT RECORD DOCUMENTS**

- A. Record Documents are to be maintained and submitted in searchable live electronic format (PDF).
1. Develop in compliance with Section 01 30 00 - Administrative Requirements.

2. Acceptable markup software:
  - a. Adobe Acrobat Professional.
  - b. Bluebeam Revu.
- B. Maintain on site one set of the following record documents; record actual revisions to the Work:
  1. Contract Drawings.
  2. Project Manual with Specifications.
  3. Addenda.
  4. Change Orders and other modifications to the Contract.
  5. Reviewed shop drawings, product data, and samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- C. Ensure entries are complete and accurate, enabling future reference by District.
- D. Store record documents separate from documents used for construction.
- E. Record information concurrent with construction progress.
- F. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by Addenda and modifications.
  4. Provide copies of all approved addenda, directives, corrections, and change orders affecting the associated project.
    - a. These copies shall be included with the "Bid Set" and/or "Record Set" listed above and formatted as detailed above.
- G. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  1. Reproducible set of Contract Drawings will be provided to Contractor by District through Architect or Construction Manager.
  2. Measured depths of foundations in relation to finish first floor datum.
  3. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  5. Field changes of dimension and detail.
  6. Details not on original Contract drawings.
    - a. Application of copies of details produced and provided by Architect during construction will be accepted.
- H. Submission: Submit Record Documents in searchable (live text and redlines mark-ups; not scanned) PDF format to Architect prior to final Application for Payment.

1. Maintain one additional paper copy and one in PDF format (on CD) of the fire suppression and fire protection detection system drawings and specifications at the building premises.
  - a. One copy is to be kept on site for a period of three years to comply with CFC section 901.6.2.

### **3.02 OPERATION AND MAINTENANCE DATA**

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

### **3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

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

### **3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  1. Description of unit or system, and component parts.
  2. Identify function, normal operating characteristics, and limiting conditions.
  3. Include performance curves, with engineering data and tests.
  4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.



- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
  - 1. Parts Data:
    - a. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams as necessary for service and maintenance.
    - b. Include complete nomenclature and catalog numbers for consumable and replacement parts.
    - c. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in stock by the District or operator.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in individual product specification sections.

### **3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS**

- A. Assemble operation and maintenance data into durable manuals for District's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
  - 1. Provide duplicate electronic formatted (PDF) versions of the O&M binder for record purposes. Organize the same as the printed versions.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
  - 1. Project Directory.
  - 2. Table of Contents, of all volumes, and of this volume.
  - 3. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Source data.
    - b. Product data, shop drawings, and other submittals.
    - c. Operation and maintenance data.
    - d. Field quality control data.
    - e. Photocopies of warranties and bonds.
  - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

### **3.06 WARRANTIES AND BONDS**

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with District's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Project Warranty and Guarantee Forms:
  - 1. Example forms for special Project warranties and guarantees are included at the end of this Section.
  - 2. Prepare written documents utilizing the appropriate form, ready for execution by the Contractor, or the Contractor and subcontractor, supplier or manufacturer.
    - a. Submit a draft to District through Architect for approval prior to final execution.
  - 3. Refer to product Specifications Sections of Divisions 2 through 33 for specific content requirements, and particular requirements for submittal of special warranties.

4. Prepare standard warranties and guarantees, excepting manufacturers' standard printed warranties and guarantees, on Contractor's, subcontractor's, material supplier's, or manufacturer's own letterhead, addressed to District.
  5. Warranty and guarantee letters shall be signed by all responsible parties and by Contractor in every case, with modifications only as approved in advance by District to suit the conditions pertaining to the warranty or guarantee.
- C. Manufacturer's Guarantee Form:
1. Manufacturer's guarantee form may be used in lieu of special Project form included at the end of this Section.
  2. Manufacturer's guarantee form shall contain appropriate terms and identification, ready for execution by the required parties.
  3. If proposed terms and conditions restrict guarantee coverage or require actions by District beyond those specified, submit draft of guarantee to District through Architect for review and acceptance before performance of the Work.
  4. In other cases, submit draft of guarantee to District through Architect for approval prior to final execution of guarantee.
- D. Signatures: Signatures shall be by person authorized to sign warranties, guarantees and bonds on behalf of entity providing such warranty, guarantee or bond.
- E. Co-Signature: All installer's warranties and bonds shall be co-signed by Contractor. Manufacturer's guarantees will not require co-signature.
- F. Verify that documents are in proper form, contain full information, and are notarized.
- G. Co-execute submittals when required.
- H. Retain warranties and bonds until time specified for submittal.
- I. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- J. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
1. If more than one volume of warranties, guarantees and bonds is produced, identify volume number on binder.
- K. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- L. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- M. Form of Warranty and Bond Submittals:
1. Prior to final Application and Certificate for Payment, compile two copies of each required warranty, guarantee and bond, properly executed by Contractor, or jointly by Contractor, subcontractor, supplier, or manufacturer.

2. Collect and assemble all written warranties and guarantees into binders and deliver binders to District for final review and acceptance.
3. Include Table of Contents for binder, neatly typed, following order and Section numbers and titles as used in the Project Manual.
4. Provide heavy paper dividers with celluloid or plastic covered tabs for each separate warranty.
  - a. Mark tabs to identify products or installation, and Section number and title.
5. Include on separate typed sheet, if information is not contained in warranty or guarantee form, a description of the product or installation, and the name, address, telephone number and responsible person for applicable installer, supplier and manufacturer.
6. When operating and maintenance data manuals are required for warranted construction, include additional copies of each required warranty and guarantee in each required manual.
  - a. Coordinate with requirements listed in the prior articles for operating and maintenance data manuals.

### **3.07 TIME OF WARRANTY AND BOND SUBMITTALS**

- A. Submission of Preliminary Copies:
  1. Unless otherwise specified, obtain preliminary copies of warranties, guarantees and bonds within ten days of completion of applicable item or Work.
  2. Prepare and submit preliminary copies for review as specified herein.
- B. Submission of Final Copies:
  1. Submit fully executed copies of warranties, guarantees and bonds within ten days of date identified in Certificate of Completion but no later than three days prior to date of final Application for Payment.
- C. Date of Warranties and Bonds:
  1. Unless otherwise directed or specified, commencement date of warranty, guarantee and bond periods shall be the date established in the Certificate of Completion.
  2. Warranties for Work accepted in advance of date stated in Certificate of Completion:
    - a. When a designated system, equipment, component parts or other portion of the Work is completed and occupied or put to beneficial use by District:
      - 1) By separate agreement with Contractor, prior to completion date established in the Certificate of Completion, submit properly executed warranties to District within ten days of completion of that designated portion of the Work.
      - 2) List date of commencement of warranty, guarantee or bond period as the date established in the Certificate of Completion.
  3. Warranties for Work not accepted as of date established in the Certificate of Completion:
    - a. Submit documents within ten days after acceptance, listing date of acceptance as beginning of warranty, guarantee or bond period.
- D. Duration of Warranties and Guarantees:
  1. Unless otherwise specified or prescribed by law, warranty and guarantee periods shall be not less than the Correction Period required by the Conditions of the Contract.

2. In no case, the period is to be less than one year from the date established for completion of the Project in the Certificate of Completion.
3. See product Specifications Sections of the Project Manual for extended warranty and guarantee beyond the minimum one year duration.

**END OF SECTION**



**SECTION 01 78 00.01  
WARRANTY FORM LETTER**

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

CONTRACTOR'S/SUBCONTRACTOR'S/SUPPLIER'S LETTERHEAD

**SPECIAL LIMITED PROJECT WARRANTY FOR \_\_\_\_\_ WORK.**

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

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

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

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

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

**CONTRACTOR:**

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

**FORM LETTER**





**FORM LETTER**

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

CONTRACTOR'S / MANUFACTURER'S LETTERHEAD

**SPECIAL LIMITED PROJECT [\_\_WARRANTY\_\_] [\_\_GUARANTEE\_\_] FOR \_\_\_\_\_ WORK.**

We, the undersigned, do hereby [\_\_warrant\_\_] [\_\_guarantee\_\_] that the portion of the Work described above which [\_\_we have provided\_\_] [\_\_was provided by (Installer or Subcontractor's Name)\_\_] for Leffingwell ES Modernization in accordance with the Contract Documents and that all such Work as installed will fulfill or exceed all minimum warranty requirements. We agree to repair or replace Work installed by [\_\_us,\_\_] [\_\_(Installer or Subcontractor's Name)\_\_] together with any adjacent Work which is displaced or damaged by so doing, that proves to be defective in workmanship, material, or function within a period of (years), commencing (date indicated in Certificate of Completion, unless otherwise directed) and terminating (date).

The following terms and conditions apply to this [\_\_warranty\_\_] [\_\_guarantee\_\_] (obtain District's approval before submission):

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

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

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

**CONTRACTOR:**

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

**FORM LETTER**

**END OF SECTION**

**SECTION 01 79 00**  
**DEMONSTRATION AND TRAINING**

**PART 1 GENERAL**

**1.01 SUMMARY**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 91 13 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.
- B. Other Specification Sections: Additional requirements for demonstration and training.

**1.03 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Training Plan: District will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Each Sub, Design-Builder SubContractor and vendor responsible for training submits a written training plan to the Architect and District Representative for review and approval prior to training.
  - 2. Submit to Architect for transmittal to District.
  - 3. Submit not less than four weeks prior to start of training.
  - 4. Revise and resubmit until acceptable.
  - 5. Provide an overall schedule showing all training sessions.
  - 6. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
      - 1) Equipment list

- c. Name of firm and person conducting training; include qualifications.
  - d. Intended audience, such as job description.
  - e. Objectives of training and suggested methods of ensuring adequate training.
    - 1) Agenda and subjects (design intent, equipment inspections, modes of operation, system interactions, troubleshooting, preventative maintenance, etc.)
  - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
  - g. Media to be used, such as slides, hand-outs, etc.
    - 1) The approved O&M manuals shall be used during the training for equipment specific references.
  - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
- 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
- 1. Identification of each training session, date, time, and duration.
  - 2. Sign-in sheet showing names and job titles of attendees.
  - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
  - 4. Include Commissioning Authority's formal acceptance of training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for District's subsequent use.
- 1. Format: DVD Disc.
  - 2. Label each disc and container with session identification and date.

#### **1.04 QUALITY ASSURANCE**

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

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 TRAINING OF OWNER PERSONNEL**

- A. The Contractor and Design-Builder SubContractors shall be responsible for training coordination and scheduling and for ensuring that training is completed.
- B. The Commissioning Authority (CA) shall be responsible for reviewing and approving the content of the training of Owner personnel for commissioned equipment.
- C. The specific training requirements of District personnel by Subs, Design-Builder SubContractors and vendors is specified in the Division in which the equipment is specified.
- D. For primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

### **3.02 DEMONSTRATION - GENERAL**

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

### **3.03 TRAINING - GENERAL**

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. District will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of District's personnel to be trained; re-schedule training sessions as required by District; once schedule has been approved by District

failure to conduct sessions according to schedule will be cause for District to charge Contractor for personnel "show-up" time.

- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.
  - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  - 10. Review spare parts and tools required to be furnished by Contractor.
  - 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION**

## SECTION 01 91 13

### GENERAL COMMISSIONING REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Commissioning Plan
- B. Pre-Functional Checklists
- C. Functional Performance Test Procedures

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Commissioning Team
  - 2. Commissioning Meetings
  - 3. Construction Checklist Overview
  - 4. Controls Verification
  - 5. Functional Performance Testing
  - 6. Training Development
  - 7. Commissioning Plan

##### 1.3 DEFINITIONS

- A. BoD: Basis of Design. A document, prepared by Engineer, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document, prepared by CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document prepared by Owner that details the functional requirements of a Project and expectations of how it will be used and operated. This document includes Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Assemblies, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment, and components.
- F. TAB: Testing, Adjusting, and Balancing.

##### 1.4 DESCRIPTION

- A. The Owner has elected to use the Commissioning Process as part of their quality assurance process to design, construct, and operate this building. As with any quality process, Commissioning provides tools to enable everyone involved in the construction of a building to verify the final building meets the original intent of the Owner. A primary tool used is the completion of pre-functional checklists by individual workers. The

checklists are simple to fill out and easily track the current state of work by providing the key criteria in the specifications the Owner has defined as important for the successful installation and long-term operation of systems and equipment.

- B. A key component of Commissioning is the verification of the operation of heating, cooling and lighting systems in all modes of operation to ensure the building is ready for year-round occupancy.
- C. Commissioning provides focused training of operation and maintenance personnel by ensuring that detailed training agendas are utilized and requiring detailed submittal requirements from Contractors prior to accomplishing any training.
- D. The commissioning scope of work shall encompass all new mechanical, electrical and plumbing systems.

### **1.5 INCLUDED SYSTEMS**

- A. The following systems and their components are the focus of the Commissioning Process due to their complexity and the need to have coordination among the various contractors:
  - 1. Rooftop Packaged AC Units
  - 2. Exhaust Fans
  - 3. Ductless Split System
  - 4. Building Automation System
  - 5. Electric Water Heaters
  - 6. Interior Lighting Controls
  - 7. Exterior Lighting Controls

### **1.6 SCHEDULE**

- A. The Contractor shall provide a detailed construction schedule within 30 days of the commencement of work. The Contractor shall also provide schedule updates throughout the construction period. Schedules shall include all submittals; equipment start-up activities; ductwork testing; pipe flushing; Test, Adjust, and Balance; and Owner training. The Architect will provide the Contractor with commissioning activities to include into the overall project schedule.
- B. The Contractor shall notify the Architect 14-days prior to equipment startup, ductwork testing, pipe testing and flushing, water treatment certification, and AHJ inspections. All documentation shall be sent to the Architect for record.
- C. Contractor shall complete pre-functional checklists and installation checklists daily.
- D. Contractor shall provide coordinated shop drawings monthly or as requested to verify that all trades are coordinating in a reasonable and logical manner.
- E. Contractor shall submit proposed startup procedures for review 14-days prior to startup.
- F. Contractor shall submit completed startup reports prior to scheduling functional testing.
- G. Contractor shall submit trending for review 7-days prior to functional performance testing. Trending duration shall be for 7-days on 30-minute intervals and shall include all points as requested by CxA. Functional testing will not be scheduled prior to Architect approving trends.
- H. Contractor shall be responsible for 10% TAB Verification.



- I. FPT (Functional Performance Test) procedures will be developed by the CxA (see item 3.14). The contractor shall return consolidated comments from all subcontractors within 14 days of receipt.
- J. Contractor shall be responsible for participating in functional performance testing at end of construction, opposite season testing, and at 10-month warranty review.
- K. Contractor shall submit O&M Manuals and warranties within 30 days of receiving approved product submittals and shop drawings.
- L. Contractor shall submit Training Materials and Agendas 30 days prior to scheduled training.

## **PART 2 PRODUCTS – NOT USED**

## **PART 3 EXECUTION**

### **3.1 COMMISSIONING TEAM**

- A. The Contractor and each subcontractor shall designate a single individual to be responsible for coordinating Cx activities with Owner and CxA.
- B. The members of the commissioning team consist of Owner, Owner O&M personnel, Prime Contractor, either the General Contractor (GC) or the Mechanical Contractor (MC), the Electrical Subcontractor(s) (ES), the plumbing subcontractor (PC) the Testing Adjusting and Balancing (TAB) subcontractor, the Controls Subcontractor (CS), and the Commissioning Authority (CxA).

### **3.2 COMMISSIONING MEETINGS**

- A. All commissioning team members shall attend preconstruction Cx meeting. The meeting will be to discuss the Cx process, scheduled activities, and Cx team responsibilities.
- B. Commissioning meetings will be held throughout the duration of construction and will typically follow a scheduled project coordination meeting. Commissioning meetings will be separate from other meetings and will have their own agenda and meeting minutes. The CxA will lead, distribute agendas, and record meeting minutes for Cx meetings. The meetings are not to be redundant to other meetings and will be to discuss quality issues and commissioning activities.

### **3.3 COMMISSIONING PLAN**

- A. A detailed commissioning plan containing the OPR, designer's Basis of Design (if available), and a compilation of all test forms and training requirements will be provided and reviewed with the subcontractors during the pre-construction workshop.
- B. The commissioning plan is intended only as a guide for commissioning activities on the project. The specifications are the contract requirements and shall be considered the extent of the subcontractor's responsibilities.

### **3.4 DOCUMENTATION**

- A. All documentation shall be sent to the Architect for record.

### 3.5 SUBMITTAL REVIEWS

- A. The Commissioning Authority (CxA) shall review submittals concurrent to the Architect. The intent of this review is to identify long-term issues of submitted equipment and to ensure the original design intent is maintained throughout the design and construction phases. Comments of the CxA will be coordinated through the Architect. The focus of the CxA review will be:
1. Verify that the equipment or system meets the Owner's Project Requirements.
  2. Verify that equipment or system includes provisions for access and maintenance.

### 3.6 CONSTRUCTION CHECKLIST OVERVIEW

- A. The intent of the construction checklist is to provide a formalized means to easily track construction progress and to provide individual workers the key criteria for a successful installation.
1. Pre-functional checklists are described in detail below. These are equipment specific.
  2. Checklists for piping, ductwork, cable trays, wiring, etc. are different from the pre-functional checklists. Although they are not formally tracked, they will be used by the CxA during periodic site observations. These checklist items are reminders to the contractors of some common items that have been problematic on other projects.
- B. Construction checklists for all pieces of equipment typically follow the same format yet are tailored to the specific equipment being installed.
- C. Pre-functional and Construction checklists are developed for each individual piece of equipment to track and verify equipment from when they are delivered, installed, and started up. The contractor will be provided with all checklists developed for each piece of equipment or system and the following:
1. Instructions and Checklist Procedures.
  2. Checklists with the following sections:
    - a. Pre-Installation Checks: Includes several yes/no or short answer questions to document the condition of the equipment prior to installation and several blank columns to compare delivery items such as manufacturer, model, serial no., etc. to the corresponding submitted/approved items.
    - b. Installation and Startup: Includes several yes/no or short answer questions to document that the equipment is installed, electrically wired, controlled and started up and balanced according to the specified requirements. A Negative Responses section is included at the end of the checklist to document the reasons for any "no" responses or discrepancies in the various sections. A space is included to document the actions taken to correct the problems resulting in "no" responses.

- D. The construction checklists shall be distributed by the supervisor to individual workers (teams) at the start of each day for the equipment or system to be installed or worked on that day.
- E. The checklist shall be completed by the individual actually completing the work. Prior to any work, the checklist shall be reviewed by the individual contractor for pertinent information. Any negative responses on the checklist shall be explained and documented at the end of the checklist. The CxA will review each checklist with the respective contractor(s) prior to the installation of the first component of an item (e.g., the first unit heater) to ensure they understand the use of the checklist.
- F. All Installation Checklists shall be returned to the supervisor upon completion of the work at the end of each day. The CxA will retrieve completed checklists and retain for documentation, progress will be documented by CxA and distributed to the Cx Team.
- G. The completion of the checklist does not eliminate the contractor's responsibility for meeting other requirements in the specifications and drawings.
- H. The CxA will periodically verify the accuracy, completeness and tracking of the checklists. If consistent errors are found, the responsible contractor shall re-validate 100% of the checklists for the problem equipment or system type.
- I. The Checklists are designed to detect and eliminate delivery, installation and startup problems, and problems with miscommunication. This process also serves as a convenient way to document the progress of the work.

### **3.7 SITE OBSERVATION AND ISSUES LOG**

- A. The CxA will perform routine site observations during the construction period.
- B. The CxA will maintain an Issues Log that will include construction issues, access and maintenance issues, safety issues, or other issues. Each observation is intended to improve the project quality and achieve the OPR.
- C. The CxA Issue Logs are not “punch lists” in that they focus on systemic problems. Where an issue is identified, not all of the same components will have been verified by the CxA.
- D. The contractor shall respond to the Issue Logs within 7-days.

### **3.8 START-UP**

- A. Startup reports shall be prepared prior to start-up and submitted to the Architect for A/E, Owner, and CxA review.
- B. Startup documentation shall contain a minimum of all startup procedures recommended by manufacturer and shall encompass all accessories and sensor calibration.
- C. Completed start-up reports shall be submitted 7-days prior to scheduled functional performance testing. Start-up reports shall be type written on contractor’s letterhead.

### **3.9 O&M MANUALS**

- A. O&M Manuals and Warranties shall be submitted to the Architect for Owner and CxA review.
- B. Distribution process shall be the same as Submittal Review.

- C. The O&M manuals shall include every piece of equipment and building operating system. See section 01 78 00 for more detail.

### 3.10 TRAINING

- A. The contractor is responsible for the development of the training material for the system. The contractor shall utilize the Operations and Maintenance Manual as a basis for instruction. Any coordination of training between different subcontractors is the responsibility of the contractor.
- B. The contractor shall submit the training agendas and material to the Architect 30 days prior to the originally scheduled system training for review and acceptance for review. The CxA shall provide comments to supplement the training material for operations and maintenance personnel where appropriate. Training Agendas shall include:
  - 1. Instructors Name
  - 2. Date of training
  - 3. Duration
  - 4. General purpose of the system
  - 5. Use of the O&M manuals
  - 6. Review of control drawings and schematics
  - 7. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms
  - 8. Interactions with other systems, adjustments and optimizing methods for energy conservation, relevant health and safety issues
  - 9. Preventative maintenance procedures and schedules. Schedule should be broken out by system and each component requiring maintenance.
  - 10. Special maintenance and replacement sources
  - 11. Tenant interaction issues
  - 12. Discussion of how the feature or system is environmentally responsive
  - 13. The trainer shall verify that the training agenda is covered and shall obtain signatures and names of persons attending the training.
- C. CxA will review training agenda and materials concurrent with Owner and A/E.
- D. Distribution process shall be the same as Submittal Review.
- E. Training shall be recorded by the Contractor with 3 copies supplied to Owner in DVD format.
- F. All training sessions shall be scheduled and coordinated by the Contractor through Owner.
- G. Major component training shall be completed and accepted by Owner prior to substantial completion and occupancy.

### 3.11 CONTROL SYSTEM VERIFICATION

- A. Included in this work will be sample-based verification of instrument calibration, access to components, labeling of devices, clear sequences and shop drawings.

- B. The verification of the control system will be accomplished as an on-going task during construction to identify and resolve systemic issues early in the project. This on-going task will involve work that occurs offsite and throughout the construction phase including the closeout phase.
- C. The control system operation must be sufficiently operational prior to the TAB of the system. It is understood that a portion of the final control system startup occurs in conjunction with the TAB work. The intent of this requirement is for the TAB work to be productive and not be hampered by a control system that is not sufficiently functional.
- D. The control system testing will utilize the controls system instrumentation for testing. Therefore, the first portion of the control system testing will be verification of the sensors, inputs and outputs.
- E. Point-to-Point Verification: All wiring shall be checked out by the Contractor from end to end, point to point, from field to computer screen to ensure correct connection and a system free from wiring defects.
- F. CxA verification of sensors will be made using the sampling method; an exhaustive re-test of the control system inputs and outputs will not be conducted by the CxA. Prior to CxA verification, the Contractor shall be responsible for complete input/output checkout quality assurance.
  - 1. Sensor and Actuator Calibration, General:
    - a. This section is included to emphasize the importance of the Contractor calibrating the instrumentation, and to make clear the requirement for same; and that “factory calibration” or “calibration by exception” is not acceptable.
    - b. All field-installed temperature, relative humidity, CO, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
    - c. All procedures used shall be fully documented on the pre-functional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
  - 2. Sensor Calibration Methods
    - a. All Sensors and Transducers. Verify that all sensor and transducer locations are appropriate and away from causes of erratic operation. Verify that sensors and transducers with shielded cable are grounded only at one end.
    - b. Sensors without Transmitters. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor is within the specified tolerances. If not, install offset in BAS, calibrate or replace sensor.
    - c. Sensors with Transmitters. Connect a signal generator. Adjust transmitter zero and span to match the signal generator until the ammeter reads 4

- mA. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading is within the specified tolerances. If not, replace sensor and repeat.
- d. Sensor Tolerances. The following are the tolerances of the actual sensors in the system. Unless noted differently on the CxA test procedure, use the following:
- 1) Temperature (space or room): +/- 1.0 degF.
  - 2) Temperature (duct): +/- 0.5 degF.
- e. Valve and Damper Stroke Setup and Check as follows:
- 1) For all valve and damper actuator positions checked, verify the actual position against the BAS readout.
  - 2) Set pumps or fans to normal operating mode (If the system could be affected by this, then shut down the system). Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator.
  - 3) Closure for normally closed valves and dampers (spring-loaded only). Disconnect power to the actuator motor and verify the valve or damper moves to full closed position. If not spring-loaded, conduct verification by disconnecting the signal wire. Restore to normal.
  - 4) Closure for normally open valves and dampers (spring-loaded only). Disconnect power to the actuator motor and verify the valve or damper moves to full open position. If not spring-loaded, conduct verification by disconnecting the signal wire. Restore to normal.

### **3.12 TEST, ADJUST, AND BALANCE VERIFICATION**

- A. The CxA shall witness the TAB activities performed by the Contractor to document achievement of the OPR. The specific activities expected include:
1. CxA will review TAB deficiencies report with Owner to evaluate existing conditions and repairs that may be required.
  2. Review of TAB procedures during process. TAB Contractor shall verify accessibility of equipment and components required for TAB work, adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces, adequate number and placement of balancing valves to allow proper balancing and recording of water flow, adequate number and placement of test ports and test instrumentation to allow reading and

compilation of system and equipment performance data needed to conduct both tab and commissioning testing.

3. Review of TAB report after TAB work is complete. Contractor shall meet with Cx Team and Owner prior to submitting final TAB report to verify TAB accuracy. The verification will be done by TAB contractor with the same equipment used to balance the system. 10% of all balanced components will be verified to be in compliance. If any component is found to be out of compliance, the TAB contractor shall be responsible to correct, and provide another 10% TAB verification. Verification will include hydronic and air-side equipment, air distribution devices, etc.
4. The TAB verification will be done while the system is under automatic control. The control system, VFD's, etc. shall not be manually controlled during verification.

### **3.13 FUNCTIONAL PERFORMANCE TESTING**

- A. The CxA will witness tests performed by the Contractor that are intended to document achievement of the OPR. The specific activities expected include:
  1. The CxA will provide to all commissioning team members, and others as required, the functional performance test plan prior to scheduled testing.
  2. Review of test procedures: the contractor shall review the FPT procedures developed by the CxA. The contractor shall return consolidated comments from all subcontractors within 14 days of receipt.
  3. FPT's shall be accomplished prior to submitting the initial request for substantial completion and after all construction checklists have been accepted by the CxA and after acceptance of all startup and performance test reports (e.g., TAB report).
  4. Contractor shall assign adequate personnel and tools for the following FPT's and any required retests:
    - a. HVAC Systems - all modes of operation, including emergency, efficiency, performance, and consistency tests.
    - b. Electrical - Review of HVAC equipment electrical connections to validate power quality within specified tolerances in all modes of operation, including emergency, efficiency, performance, and consistency tests. Review lighting control systems in all modes of operation.
    - c. Plumbing Systems - Review of HVAC equipment plumbing connections (hot water, chilled water, condensate drainage, etc.) in all modes of operation, including emergency, efficiency, performance, and consistency tests.
- B. The Contractor and applicable subcontractors will be responsible to assist the CxA by witnessing the testing, putting the system in various modes of operation, and fixing minor problems found during the test.
- C. Contractor shall be responsible for functional performance testing at end of construction, opposite season testing, and at 10-month warranty review

- D. If major problems are discovered during the test, the Contractor will fix the problem and the test shall be redone. If more than two functional performance tests are required, the Contractor will be backcharged for the CxA's time and expenses.
- E. Control system set-up, calibration and operation shall be completed and verified prior to system Adjusting and Balancing. System functional performance testing shall not be completed until the Adjusting and Balancing report has been verified and accepted by the Architect/ CxA.
- F. Skilled technicians shall be provided by the appropriate Contractor familiar with the system and building to execute the functional performance testing of the control system and perform functional performance testing of equipment. The Owner reserves the right to reject any technician who is not qualified to perform the required testing. Qualifications of technicians include site-specific expert knowledge relative to tested equipment and adequate documentation and tools to service and operate the systems.

**3.14 RECORD DRAWINGS**

- A. Contractor shall be responsible for providing coordinated shop drawing submittals to verify that all trades are coordinating in a reasonable and logical manner.

**END OF SECTION**



## **SECTION 02 41 00 DEMOLITION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

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

#### **1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 10 00 - Summary: Description of items to be removed by District.
- C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Section 07 01 50.19 - Preparation for Re-Roofing: Removal of existing roofing, roof insulation, flashing, trim, and accessories.
- H. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

#### **1.03 REFERENCE STANDARDS**

- A. AHRI 560 - Voluntary Specification for Rotary Operators in Window Applications; 2010.
- 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 East Whittier City School District, demolished materials shall become the Contractor's property and shall be removed, recycled, or disposed from Project site in an appropriate and legal manner.
  - 1. Arrange a meeting no less than ten (10) days prior to demolition with the District or Construction Manager and other designated representatives to review any 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.
- 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.
  - 4. Contractor's Waste Management and Recycling Plan: See Section 01 74 19 - Construction Waste Management and Disposal.
    - a. This plan will not otherwise relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
  - 5. Contractor's Reuse, Recycling, and Disposal Report: See Section 01 74 19 - Construction Waste Management and Disposal.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.
  - 1. Record drawings: Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

## 1.08 SUBMITTALS

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

### **1.09 QUALITY ASSURANCE**

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

### **1.10 SCHEDULING**

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

## **PART 2 PRODUCTS -- NOT USED**

## **PART 3 EXECUTION**

### **3.01 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 AHRI 560 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 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
  2. Report discrepancies to Architect before disturbing existing installation.
  3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
  2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
  2. Remove items indicated on drawings.
  3. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. See Section 01 10 00 for other limitations on outages and required notifications.
  4. Verify that abandoned services serve only abandoned facilities before removal.
  5. Remove abandoned pipe, ducts, conduits, and equipment; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.

4. Patch as specified for patching new work.

### **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 03 01 00**  
**MAINTENANCE OF CONCRETE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Cleaning of existing concrete surfaces.
- B. Repair of exposed structural, shrinkage, and settlement cracks.
- C. Resurfacing of concrete surfaces having spalled areas and other damage.
- D. Repair of deteriorated concrete.
- E. Repair of internal concrete reinforcement.
- F. Scope of Work: As indicated on the drawings and as required as work progresses for hidden conditions after consultation with the Architect.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

**1.03 REFERENCE STANDARDS**

- A. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).
  - 1. Use 2013 as indicated in the 2016 CBC Referenced Standards.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
  - 1. Use 2012 as indicated in the 2016 CBC Referenced Standards
- D. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- E. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2015.
- F. ASTM C928/C928M - Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Material for Concrete Repairs; 2013.
- G. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- H. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
  - 1. Use 2011 as indicated in the 2016 CBC Referenced Standards.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Scheduling: Perform blast cleaning only between the hours of 7 am to 10 pm.

**1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.

- B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.
- C. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.

### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Cleaner Qualifications: Company specializing in, and with minimum of 3 years of experience in, the type of cleaning specified.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum of 3 years of documented experience.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

## **PART 2 PRODUCTS**

### **2.01 CLEANING MATERIALS**

- A. Degreaser:
  - 1. Manufacturers:
    - a. Euclid Chemical Company; Euco Clean and Strip: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).
    - b. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; CITREX: [www.lmcc.com/#sle](http://www.lmcc.com/#sle).
    - c. SpecChem, LLC; Orange Peel-Citrus Cleaner: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - d. W.R. Meadows, Inc: [www.wrmeadows.com](http://www.wrmeadows.com).
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Detergent: Non-ionic detergent.

### **2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS**

- A. Manufacturers:
  - 1. Adhesives Technology Corporation: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
  - 2. ARDEX Engineered Cements: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
  - 3. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
  - 4. The QUIKRETE Companies: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
  - 5. SpecChem, LLC: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
  - 6. W. R. Meadows, Inc: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - 7. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Bonding Slurry: Water-based latex admixture complying with ASTM C1059/C1059M, combined with Portland cement and sand in accordance with admixture manufacturer's instructions.
1. Admixture Manufacturers:
    - a. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - b. The QUIKRETE Companies; QUIKRETE® Concrete Bonding Adhesive: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
    - c. SpecChem, LLC; Strong Bond - Acrylic Bonder: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - d. W. R. Meadows, Inc; Acry-lok: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat application.
1. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
  2. Recommended Thickness: Feather edge to 1/8 inch.
  3. Color: Gray.
  4. Manufacturers:
    - a. ARDEX Engineered Cements; ARDEX Feather Finish: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Duracrete: [www.lmcc.com/#sle](http://www.lmcc.com/#sle).
    - d. The QUIKRETE Companies; QUIKRETE® Concrete Resurfacer: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
    - e. SpecChem, LLC; Duo Patch: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - f. SpecChem, LLC; Final Finish: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - g. W. R. Meadows, Inc; Parge-All AF: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - h. W. R. Meadows, Inc; Meadow-Patch T2: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - i. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
1. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
  2. Integral corrosion inhibitor.
  3. Products:
    - a. Adhesives Technology Corporation; HARD-ROK JET PATCH: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
    - b. Five Star Products, Inc; Five Star Structural Concrete V/O: [www.fivestarprouducts.com/#sle](http://www.fivestarprouducts.com/#sle).
    - c. The QUIKRETE Companies; QUIKRETE® FastSet Repair Mortar: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
    - d. SpecChem, LLC; RepCon V/O: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - e. SpecChem, LLC; Duo Patch: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).

- f. W. R. Meadows, Inc; Meadow-Crete GPS: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - g. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Cementitious Repair Mortar, Form and Pour/Pump Grade: Flowable, one- or two-component, factory-mixed, polymer-modified cementitious mortar; in-place material resistant to freeze/thaw conditions.
  - 1. Mixed with water in proportions as recommended by manufacturer.
  - 2. Integral corrosion inhibitor.
  - 3. Manufacturers:
    - a. ARDEX Engineered Cements; ARDEX FDM: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - c. Five Star Products, Inc; Five Star Structural Concrete: [www.fivestarprouducts.com/#sle](http://www.fivestarprouducts.com/#sle).
    - d. SpecChem, LLC; Duo Patch; [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - e. SpecChem, LLC; RepCon H-350; [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - f. W. R. Meadows, Inc; Meadow-Crete FNP: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Cementitious Pavement Repair Mortar: Fast hardening, flowable; composed of cement, sand, and additives; capable of setting in cold weather conditions without the aid of chloride- or gypsum-based accelerators; in-place material resistant to freeze/thaw conditions.
  - 1. Dry Material: Complies with ASTM C928/C928M.
  - 2. Manufacturers:
    - a. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - b. Prospec; Premium Patch 100: [www.prospec.com](http://www.prospec.com).
    - c. Prospec; Premium Patch 200: [www.prospec.com](http://www.prospec.com).
    - d. SpecChem, LLC; RepCon 928: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - e. SpecChem, LLC; RepCon 928 FS: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - f. W. R. Meadows, Inc; Futura-15: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - g. W. R. Meadows, Inc; Futura-45 or Futura-45 Extended: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - h. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.03 EPOXY PATCHING AND REPAIR MATERIALS**

- A. Manufacturers:
  - 1. Adhesives Technology Corporation: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
  - 2. Dayton Superior Corporation: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
  - 3. SpecChem, LLC: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
  - 4. W. R. Meadows, Inc: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Epoxy Repair Mortar: Epoxy resin mixed with aggregate and other materials in accordance with manufacturer's instructions for purpose intended; comply with pot life and workability limits.

1. Manufacturers:
  - a. Adhesives Technology Corporation; Crackbond LR-321: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
  - b. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
  - c. The QUIKRETE Companies; QUIKRETE® FastSet Anchoring Epoxy: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
  - d. SpecChem, LLC; SpecPoxy 1000, SpecPoxy 2000, SpecPoxy 3000 or SpecPoxy 3000 FS: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
  - e. W. R. Meadows, Inc; Rezi-Weld Gel Paste, Rezi-Weld Gel Paste State, Rezi-Weld 1000, Rezi-Weld LV, or Rezi-Weld LV State: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - f. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Epoxy Injection Adhesive:
  1. Manufacturers:
    - a. Adhesives Technology Corporation; Crackbond LR-321: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
    - b. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - c. SpecChem, LLC; SpecPoxy 1000; [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - d. W. R. Meadows, Inc; Rezi-Weld LV, Rezi-Weld LV State, Rezi-Weld (IP), or Rezi-Weld Gel Paste: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Epoxy Bonding Adhesive: Non-sag, two-part, 100 percent solids; recommended by manufacturer for purpose and conditions under which used.
  1. Non-Load-Bearing Applications: ASTM C881/C881M Type I, II, III, IV, or V, whichever is appropriate to application.
  2. Load-Bearing Applications: ASTM C881/C881M Type IV or V, whichever is appropriate to application.
  3. Other Applications: ASTM C881/C881M Type as appropriate to application.
  4. Manufacturers:
    - a. Adhesives Technology Corporation; Crackbond LR-321: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
    - b. Adhesives Technology Corporation; Crackbond SLV-302: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
    - c. Adhesives Technology Corporation; Ultrabond 2100: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
    - d. SpecChem, LLC; SpecPoxy 2000: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - e. SpecChem, LLC; SpecPoxy 3000: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - f. SpecChem, LLC; SpecPoxy 3000 FS: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - g. W. R. Meadows, Inc; Rezi-Weld Gel Paste: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - h. W. R. Meadows, Inc; Rezi-Weld Gel Paste State: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - i. W. R. Meadows, Inc; Rezi-Weld 1000: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - j. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.04 ACCESSORIES

- A. Anchoring Adhesive: Self-leveling or non-sag as applicable.
  1. Self-Leveling Polyester-Based Products:
    - a. W. R. Meadows, Inc; Poly-Grip: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Self-Leveling Epoxy Products:
  - a. SpecChem, LLC; SpecPoxy 2000; [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
  - b. W. R. Meadows, Inc; Rezi-Weld 1000, Rezi-Weld (IP), or Rezi-Weld 3/2: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - c. Substitutions: See Section 01 60 00 - Product Requirements.
- 3. Non-Sag Epoxy Products:
  - a. Dayton Superior Corporation; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
  - b. SpecChem, LLC; SpecPoxy 3000 or SpecPoxy 3000 FS: [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
  - c. W. R. Meadows, Inc; Rezi-Weld Gel Paste or Rezi-Weld Gel Paste State: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Portland Cement: ASTM C150/C150M, Type I, grey.
- C. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.
- D. Water: Clean and potable.
- E. Reinforcing Steel: ASTM A615/A615M Grade 60 (60,000 psi) billet-steel deformed bars, unfinished.
- F. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 60 (420), Type A.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means acceptance of substrate.

#### **3.02 CLEANING EXISTING CONCRETE**

- A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.
- B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
  - 1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
  - 2. Clean out cracks and voids using same methods.
- C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
  - 1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
  - 2. Increasing the water washing pressure to maximum of 400 psi.
  - 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
  - 4. Steam-generated low-pressure hot-water washing.
- D. Do not use any of the following cleaning methods, unless otherwise indicated:

1. Brushes with wire bristles, grinding with abrasives, solvents, hydrochloric or muriatic acid, sodium hydroxide, caustic soda, or lye.
2. Soap or detergent that is not non-ionic.
3. Alkaline cleaning agents.
4. Acidic cleaning agents.
5. Abrasive blasting.

### **3.03 CONCRETE STRUCTURAL MEMBER REPAIR**

- A. See the drawings for known specific areas to be repaired (if any).
- B. Remove broken and soft concrete at least 1/4 inch deep.
- C. Mechanically cut away damaged portions of reinforcement.
- D. Remove corrosion from steel and clean mechanically.
- E. Blast clean remaining exposed reinforcement surfaces.
- F. Repair by welding new bar reinforcement to existing reinforcement using sleeve splices.
  1. Perform welding work in accordance with AWS D1.4/D1.4M.
  2. Make welded sleeve splices to achieve strength to exceed strength of new reinforcement.
- G. Cover exposed steel reinforcement with epoxy mortar.
- H. Work epoxy mortar into broken surface and build up patch to match original.
- I. Feather edges of repairs flush to sound surface and trowel surface to match surrounding area.

### **3.04 CRACK REPAIR USING EPOXY ADHESIVE INJECTION**

- A. Repair exposed cracks.
- B. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than the depth of the crack to be filled or port size diameter no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.
- C. Inject adhesive into ports under pressure using equipment appropriate for particular application.
- D. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.
- E. Remove temporary seal and excess adhesive.
- F. Clean surfaces adjacent to repair and blend finish.

### **3.05 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS**

- A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.
- B. Apply coating of bonding agent to entire concrete surface to be repaired.
- C. Fill voids with cementitious mortar flush with surface.

- D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch over entire surface, terminating at a vertical change in plane on all sides.
- E. Trowel finish to match adjacent concrete surfaces.

**3.06 FIELD QUALITY CONTROL**

- A. An independent testing agency, as specified in Section 01 40 00, will perform field inspection and testing.

**END OF SECTION**



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

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete: General requirements for concrete construction, including finish qualities..
- C. Section 04 20 00 - Unit Masonry: Reinforcement for masonry.
- D. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
- E. Section 05 50 00 - Metal Fabrications: Placement of embedded steel anchors and plates in cast-in-place concrete.
- F. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.

**1.03 REFERENCE STANDARDS**

- A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 301 - Specifications for Structural Concrete; 2016.
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).
  - 1. Use 2014 as indicated in 2016 CBC Ch 35 Referenced Standards.
- D. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).
- E. PS 1 - Structural Plywood; 2009.
- F. CBC Chapter 19A.

**1.04 DEFINITIONS**

- A. Unexposed Finish: A general-use finish, with no appearance criteria, applicable to all formed concrete concealed from view after completion of construction.
- B. Exposed Finish: A general-use finish applicable to all formed concrete exposed to view and including surfaces which may receive a paint coating (if any).

**1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.

- B. Product Data: Provide data on void form materials and installation requirements.
  - 1. Form release agent.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

### **1.06 QUALITY ASSURANCE**

- A. Industry Standard: Formwork design and construction shall be in accordance with 1, 3, and 2.
- B. Maintain one copy of each installation standard on site throughout the duration of concrete work.
- C. Regulatory Requirements: Conform to formwork construction requirements of the California Building Code (CBC) Title 24, Part 2, Chapter 19A as amended and adopted by authorities having jurisdiction.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

## **PART 2 PRODUCTS**

### **2.01 FORMWORK - GENERAL**

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.
- F. Provide materials for contact with concrete which impart suitable surface quality to completed concrete. Use the following form types:
  - 1. Forms for Exposed Finish Concrete:
    - a. Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces.
    - b. Furnish in largest practical sizes to minimize number of joints and to conform to joint system shown on the Drawings.
  - 2. Forms for Unexposed Finish Concrete:
    - a. Plywood, lumber, metal, or another acceptable material.
    - b. Provide lumber dressed on at least two edges and one side for tight fit.
    - c. When unexposed concrete is intended to receive waterproofing, provide form as for exposed finish concrete.

- G. Provide materials to construct formwork to support forming materials in contact with concrete, of sufficient capacity to withstand pressures of concrete placement and to support concrete in place until cured, without distortion.

## 2.02 WOOD FORM MATERIALS

- A. Softwood Plywood for Concealed Surfaces: PS 1, undamaged face C Grade, Group 2 Plugged EXT or APA Structural I Sheathing.
- B. Hardboard: For curved surfaces, tempered hardboard, Masonite Corp., or equal.
- C. Lumber: Douglas fir or douglas fir-larch species; appropriate for intended use grade; with grade stamp clearly visible.
  - 1. Sound and undamaged straight edges, and solid knots, to maintain principal shores to support concrete until minimum strength is achieved as approved by Structural Engineer.
- D. Embedded Nailers: Clear all heart redwood or pressure preservative-treated (PPTDF) douglas fir, edges reverse beveled to key into concrete.

## 2.03 FORMWORK ACCESSORIES

- A. Form Ties: Removable, adjustable-length or snap-off type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
  - 1. Do not use materials containing diesel oil or petroleum-based compounds.
  - 2. Does not impair subsequent treatments of concrete surfaces or bond of applied coatings.
  - 3. VOC Content: None; water-based.
  - 4. Products:
    - a. SpecChem, LLC; Bio Strip WB (water-based): [www.specchemllc.com/#sle](http://www.specchemllc.com/#sle).
    - b. W. R. Meadows, Inc; Duogard: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- D. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 50 00 .
- E. Screed Pins and Chairs:
  - 1. Provide units that leave no metal closer than 1-1/2 inch to the plane of the exposed concrete surface.
  - 2. Manufacturers:
    - a. Grann Adjustable Quick Screed (800/554-7266).
    - b. Dayton Richmond (800/745-3700).
    - c. Aztek (877/531-3344).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 SYSTEM REQUIREMENTS**

- A. Formwork Design Requirements: Formwork products and execution specified herein are for finish surface quality only.
  - 1. Design, layout and construction of formwork shall be solely the responsibility of the Contractor.
  - 2. Design and construct formwork, shoring and bracing to conform to California Building Code (CBC), Title 24, Part 2, Chapter 19A requirements and 1.
  - 3. Resulting concrete shall conform to shapes, lines and dimensions indicated and required.
- B. Coordination:
  - 1. Coordinate Work specified in this Section with other Sections which require placement of embedded products and provision of openings and recesses.
  - 2. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from the Architect before proceeding.

### **3.03 EARTH FORMS**

- A. Earth (Soil) Forms, General: Except as otherwise indicated on Drawings, conform to 1, 2 and California Building Code (CBC) requirements. Refer also to notes on Structural Drawings.
- B. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

### **3.04 ERECTION - FORMWORK**

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of 2, 3 and California Building Code (CBC) Title 24, Part 2 requirements.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
  - 1. Use form ties of sufficient strength and sufficient quantities to prevent formwork spreading.
  - 2. Maintain principal shores to support concrete until minimum required strength is achieved.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
  - 1. Design and fabricate forms for easy removal, without impact, shock, or damage to concrete surfaces or other portions of the work.
  - 2. Design to support all applied loads until concrete is adequately cured, within allowable tolerances and deflection limits.
- D. Align joints and make watertight. Keep form joints to a minimum. Make forms watertight to prevent leakage of concrete mortar. Locate form joints, at exposed concrete, to be

symmetrical about center of panel, unless otherwise noted. Align joints symmetrically at exposed conditions.

- E. Permanent openings: Provide openings to accommodate Work specified in other Sections. Size and locate openings accurately. Securely support items built into forms; provide additional bracing at openings and discontinuities in formwork.
- F. Temporary openings: Provide temporary openings for cleaning and inspection. Provide drain openings at bottoms of formwork to allow water to drain. Locate temporary openings in most inconspicuous locations at base of forms, closed with tight-fitting panels designed to minimize appearance of joints in finished concrete Work.
- G. Obtain approval before framing openings in structural members that are not indicated on drawings.
- H. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- I. Coordinate this section with other sections of work that require attachment of components to formwork.
- J. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.
- K. Inspection: Before placing of concrete, and after placement of reinforcing steel in the forms, provide notification so that proper inspection can be made. Make such notification at least 2 working days in advance of placing concrete.
- L. Rejection of Defective Work: Any movement or bellying of forms during construction or variations in excess of the tolerances specified shall be considered just cause for the removal of such forms and, in addition, the concrete construction so affected. Reconstruct forms, place new concrete and required reinforcing steel at no additional cost to the District.

### **3.05 APPLICATION - FORM RELEASE AGENT**

- A. Form Release Agent: Provide either form materials with factory applied non-absorptive liner or field applied form coating which shall comply with applicable air quality regulations for VOC. If field applied coating is employed, thoroughly clean and recondition formwork and reapply coating before each use. Rust on form surfaces is not acceptable.
- B. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- C. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- D. Do not apply form release agent where concrete surfaces to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

### **3.06 INSERTS, EMBEDDED PARTS, AND OPENINGS**

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
  - 1. Install accessories in accordance with manufacturer's instructions and referenced standards, level, straight and plumb.
- B. Locate and set in place items that are cast directly into concrete.

- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
  - 1. Openings: Size and locate formed openings, depressions, recesses and chases to accommodate products to be applied to, built into and pass through concrete Work. Coordinate size, location and placement of inserts, embedded products, openings and recesses with Work specified in other Sections.
  - 2. Anchors and Other Devices: Set and build into concrete formwork anchorage devices and other embedded products required for Work to be attached to or supported by concrete elements.
  - 3. Locating Embedded Products and Openings: Use setting drawings, diagrams, instructions and templates to set embedded products.
  - 4. Screeds: Set screeds and establish level for tops of concrete slabs and leveling for finish surfaces. Shape surfaces as indicated on the Drawings. Provide cradle, pad or base type screed supports for concrete over waterproof membranes and vapor retarders.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints are not apparent in exposed concrete surfaces.

### **3.07 FORM CLEANING**

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
  - 1. At above grade forms, flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
  - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.
- C. Formwork Reuse: Do not reuse wood and plywood forming materials which contact concrete, except as follows:
  - 1. High density plywood may be cleaned and reused for exposed concrete.
  - 2. Unfaced plywood may be reused for concealed concrete.
  - 3. Steel and fiberglass forming materials may be cleaned and reused.
- D. Patching and Repairs: Patch tie holes with sheet metal patches and restore forms to like new condition prior to reuse.

### **3.08 FORMWORK TOLERANCES**

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.
  - 1. Also as specified in 2, 1, and 4, unless otherwise specified or indicated.
- B. Camber slabs and beams in accordance with ACI 301.

### 3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
  - 1. Comply with CBC Table 1705A.3, item 12.
- C. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

### 3.10 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
  - 1. Comply with California Building Code (CBC) requirements.
  - 2. Formwork supporting weight of concrete may not be removed until concrete has reached a minimum of specified 28-day compressive strength and no earlier than 21 days after pour.
  - 3. Removal of Load Bearing Formwork:
    - a. Do not remove shoring and forms supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, until concrete has attained its 28 day specified compressive strength, unless otherwise specified or permitted by the Structural Engineer of Record.
    - b. Determine the actual compressive strength has attained is adequate to support the weight of the concrete and superimposed loads.
    - c. Maintain curing and protection operations after form removal.
  - 4. Removal of Non Load Bearing Formwork After Superimposed Loads or as Approved by Engineer:
    - a. Provided that concrete has hardened sufficiently, that it is not damaged, and has achieved sufficient strength to support its own weight and all imposed construction and design loads, forms not actually supporting weight of concrete or weight of soffit forms may be removed after concrete has cured at not less than 50 degrees F for 24 hours.
    - b. Maintain curing and protection operations after form removal.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
  - 1. Remove formwork progressively so no unbalanced loads are imposed on structure. Remove formwork without damaging concrete surfaces.
  - 2. Remove or snap off metal spreader ties inside wall surface. Cut nails and form ties off flush and leave surfaces level and clean.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

### **3.11 PATCHING**

- A. Schedule: Patch forming and tie holes immediately after form removal.
- B. Cleaning: Clean surface of all loose materials and soiling.
- C. Patching: Patch all holes and depressions with grouting gun and grout mix of one part cement and 2-1/2 parts mortar sand.

### **3.12 FORMWORK SCHEDULE**

- A. Footings and Walls, Not Exposed to View: Site fabricated plywood or lumber, coated with form release agent.
- B. Footings and Walls, Exposed to View: Site fabricated plywood, coated with form release agent compatible with applied finish coatings.

**END OF SECTION**



**SECTION 03 20 00**  
**CONCRETE REINFORCING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Division 26 - Electrical: Grounding connection to concrete reinforcement.

**1.03 REFERENCE STANDARDS**

- A. ACI 301 - Specifications for Structural Concrete; 2016.
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).
  - 1. Use 2014 as indicated in 2016 CBC Ch 35 Referenced Standards.
- C. ACI SP-66 - ACI Detailing Manual; 2004.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
  - 1. Use 2012 as indicated in 2016 CBC Ch 35 Referenced Standards.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- F. CRSI (DA4) - Manual of Standard Practice; 2009.
- G. CRSI (P1) - Placing Reinforcing Bars; 2011.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Product Data:
  - 1. Reinforcement supporting and spacing devices at exposed concrete only, to demonstrate non-corroding and non-staining characteristics.
  - 2. Adhesive compounds.
- C. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- D. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- E. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

- F. Quality Control Submittals: Submit the following information related to quality assurance requirements specified:
1. Certifications: Submit to the testing laboratory mill test certificates for all reinforcing steel, showing physical and chemical analysis. If steel is to be welded, include in chemical analysis the percentages of carbon, manganese, copper, nickel, and chromium, and optionally the percentages of molybdenum and vanadium.
  2. Certifications: If steel is to be welded, submit certifications to the testing laboratory signed by AWS Certified Welding Inspector (CWI) of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualification of welding operators, and qualification of welders.

### **1.05 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with CRSI (DA4), CRSI (P1), ACI 301, and ACI 318.
1. Maintain one copy of each document on project site.
- B. Regulatory Requirements: Conform to California Building Code (CBC) Title 24 Part 2, Chapter 19A requirements as amended and adopted by authorities having jurisdiction, for details of reinforcement.
- C. Provide Architect, Project Inspector, and Special Inspector with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

### **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Delivery: Deliver reinforcement bars new and free from rust and mill scale in original bundles marked with durable identification tags.
- B. Storage: Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening coatings.
- C. Handling: Take precautions to maintain reinforcement identification after bundles are broken.

## **PART 2 PRODUCTS**

### **2.01 REINFORCEMENT**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
1. Deformed billet-steel bars.
  2. Unfinished.
- B. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.
- C. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
  2. Chairs, Bolsters, Bar Supports, Spacers: Wire-bar-type devices, complying with 1, for spacing, supporting and fastening reinforcing bars and welded wire reinforcement in place. Sized and shaped for adequate support of reinforcement during concrete placement.

- a. Supports at Slab on Grade: Provide devices with load-bearing pads or horizontal runners where base material does not support chair legs, to prevent puncture of vapor retarder/barrier or provide precast concrete block bar supports of equal or greater strength to specified concrete.
- b. Corrosion Resistance:
  - 1) Provide stainless steel or plastic components for placement within 1-1/2 inches of weathering surfaces.
    - (a) Provide plastic coated, plastic-tipped (CRSI, Class 1) or stainless steel types at exposed-to-view concrete surfaces.
    - (b) Provide only stainless steel (CRSI Class 2) at exterior exposed surfaces to be painted.

## **2.02 RE-BAR SPLICING:**

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing 160% of steel reinforcing design strength in tension and compression.
- B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; Type II capable of developing 160% of steel reinforcing design strength in tension and compression.

## **2.03 FABRICATION**

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Locate reinforcing splices not indicated on drawings at point of minimum stress. See Structural Drawings,
  - 1. Review locations of splices with Architect (Structural Engineer) before fabrication and placement. .

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Cleaning: Clean reinforcement to remove loose rust and mill scale, soil, and other materials which may reduce or destroy bond with concrete.
- B. Adjustment and Inspection: Do not bend or straighten reinforcement in a manner injurious to material. Do not use bars with kinks or bends not shown on Drawings and reviewed shop drawings, or bars with reduced cross-section due to corrosion or other cause.
- C. Do not bend bars No. 5 and larger in the field.
- D. Do not bend bars more than once in the same location.

### **3.02 PLACEMENT**

- A. General: Place and secure reinforcement as specified herein, as indicated and noted on Drawings and in compliance with recommended details and methods of reinforcement placement and support specified in CRSI Placing Reinforcing Bars.
- B. Place, support and secure reinforcement against displacement. Do not deviate from required position.
  - 1. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

- C. Do not displace or damage vapor barrier.
- D. Accommodate placement of formed openings.
- E. Maintain concrete cover around reinforcing as indicated on Structural Drawings:
- F. Comply with applicable code for concrete cover over reinforcement.
  - 1. If not otherwise indicated on Drawings or specified herein, provide concrete cover in compliance with 1.
- G. Bond and ground all reinforcement to requirements of Division 26.
- H. Coordination: Locate reinforcement to accommodate embedded products and formed openings and recesses.
- I. Slab on Grade Reinforcement: Do not displace or damage vapor retarder/barrier at slab on grade.
- J. Wire Reinforcement Placement: Place reinforcement in sheets as long as practicable, lapping adjoining pieces at least one full mesh and lace splices with 16 gage wire. Offset end laps in adjacent widths to prevent continuous laps. Extend reinforcement to within 1-inch of edge at slabs on grade. Cut mesh at expansion joints and full depth control joints.
- K. Dowels: Secure tie dowels in place before depositing concrete. Provide No. 3 bars for securing dowels where no other reinforcement is provided.
- L. Reinforcement Splices, General: Provide standard reinforcement splices by lapping ends, placing bars in contact and tightly wire tying. Comply with details and requirements of 1 for minimum lap of spliced bars and criteria indicated on the Drawings.
  - 1. Clearances for Splices: Wherever possible, provide minimum 1-1/2 inch clearance between sets of splices. Stagger horizontal bars so that adjacent splices are minimum 48 inches apart.
- M. Reinforcement Supports: Support reinforcement on metal chairs, spacers or metal hangers to provide required coverage and to properly locate reinforcement. Do not use wood. Avoid cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.
  - 1. Support Spacing: Space chairs and accessories in conformance with CRSI Placing Reinforcing Bars.
- N. Corrections During Concrete Placement: Maintain reinforcing steel workers on-site during placement of concrete for resetting reinforcement displaced by runways, workers and other causes.

### **3.03 FIELD QUALITY CONTROL**

- A. An independent testing agency, as specified in Section 01 40 00, will inspect installed reinforcement for conformance to contract documents before concrete placement.
  - 1. Concrete floor slabs on grade are to be continuously inspected as recommended in the geotechnical report.
- B. Inspector of Record, as specified in Section 01 45 33 - Code Testing, Special Inspections and Procedures, will inspect installed reinforcement for conformance to contract documents before concrete placement.

1. Concrete floor slabs on grade are to be continuously inspected as recommended in the geotechnical report.
- C. Defective Reinforcement Work: The following shall be considered defective and may be ordered to be removed and reconstructed at no change in Contract Time or Sum.
1. Bars with kinks or bends not shown on Drawings.
  2. Bars injured due to bending or straightening.
  3. Bars heated or bent.
  4. Reinforcement not placed in accordance with Drawings and Specifications.
  5. Rusty or oily bars.
  6. Bars exposed in surface of concrete or without adequate concrete cover.

**END OF SECTION**



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

**PART 1 GENERAL**

**1.01 SUMMARY**

The work includes the furnishing and installing of all cast-in-place concrete work including formwork and reinforcement as shown and noted on the drawings and as specified. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

**1.02 APPLICABLE STANDARDS (latest editions apply)**

A. ACI- American Concrete Institute:

1. 301, Specifications for Structural Concrete for Buildings.
2. 305, Recommended Practice for Cold Weather Concreting.
3. 306, Recommended Practice for Hot Weather Concreting.
4. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
5. 318, Building Code Requirements for Reinforced Concrete.
6. 347, Recommended Practice for Concrete Formwork.

B. ASTM- American Society of Testing and Materials, Referenced Standards

C. AWS- American Welding Society:

1. AD1.4 Structural Welding Code- Reinforcing Steel
2. A5.1 Mild Steel Covered Arc-Welding Electrodes

D. CRSI-Concrete Reinforcing Steel Institute:

1. Manual of Standard Practice
2. Recommended Practice for Placing Reinforcing Bars

E. ICC- International Code Council:

1. CBC – 2019 California Building Code (California Code of Regulations, Title 24, Part 2)

**1.03 SUBMITTALS**

A. Concrete Mix Design and Tests:

1. Submit mix designs and compressive strength test reports from previous applications for specified types of concrete.

2. One copy of all test reports shall be forwarded to DSA, the Architect, the Structural Engineer, the Inspector of Record within fourteen days of the test. Test reports shall comply with all requirements of CCR Title 24, Part 1, Section 4-335.
3. The concrete mixes shall be based on designs of a professional testing laboratory, verified by test, also in accordance with CBC Section 1905A.3 or 1905A.4.

B. Concrete Shop Drawings:

1. Joints not shown on the drawing shall be so made and located as to least impair the strength of the structural elements and shall be submitted for approval to the Owner and Structural Engineer.

C. Reinforcing Steel Shop Drawings and Mill Reports:

1. Shop Drawings of all reinforcing steel shall be submitted for approval.
2. Mill Reports for each different heat to be used on the job shall be submitted for approval. Comply with CBC, Section 1916A.2.

#### **1.04 QUALITY ASSURANCE**

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Except as modified by the requirements specified herein or the details indicated, concrete construction shall conform to the California Code of Regulations (CCR), Title 24, Chapter 19.
- C. Provide access for, and cooperate with, the inspector and testing laboratory described in Section 01 45 33 of these Specifications.
- D. Welders shall be qualified in accordance with AWS D1.4.

#### **1.05 LABORATORY TESTS AND MIX DESIGNS**

- A. General: Compression tests of concrete shall be performed by a qualified testing laboratory in accordance with Section 01 45 33.
- B. Compression Test: See Section 01 45 33, Code-Required Special Inspections and Procedures.
- C. Mix Designs:
  1. Mix designs shall be prepared by the Testing Laboratory of record under the supervision of a California Registered Civil Engineer, who shall determine mix designs to fulfill the specified requirements for strength, aggregate size and workability of concrete, and such designs shall be used in proportioning all structural concrete. Mix designs shall bear the signature of the Registered Civil Engineer. Two copies of the mix design shall be submitted to the Architect as a matter of record, and not for approval.



2. Mix designs shall be made in accordance with ACI 318-14, Chapters 3, 4 and 5 and Title 24 Part 2, Section 1904. Cost of mix designs will be paid for by the Owner.
3. Cover and clear distances between reinforcing bars shown on the drawings shall be considered in determining the aggregate size for mix designs, which may result in an aggregate size smaller than the maximum aggregate size stipulated elsewhere in this specification.
4. A list specifying the intended usage of each mix design shall be clearly shown as part of the designs.

## **PART 2 PRODUCTS**

### **2.01 FORMS:**

- A. Unless otherwise indicated, materials for formwork shall be wood, steel, fiber or reinforced plastic and of suitable quality to achieve required finishes. Contractor shall conform with considerations and recommendations in ACI-347, Chapter 3, Materials for Formwork.
- B. Unless otherwise indicated, contact surfaces in fabricated forms shall be smooth and uniform without warps, bends, dents, sags or irregular absorptive conditions and imperfections which might telegraph or product objectionable irregularities in the exposed concrete finish.
- C. Forms for Unexposed Concrete: Form concrete surfaces which will not be exposed in the finished structure with plywood, lumber, metal or other acceptable material.
- D. Lumber: Standard or better grade Douglas fir. Use boards which are surfaced on at least 2 edges and one side for a tight fit.
- E. Plywood: High Density Overlay Plyform, Class I, Exterior grade meeting the requirements of PS 1-07, 5/8 inch minimum thickness for 12 inch stud spacing and 3/4 inch minimum thickness for 16 inch stud spacing.
- F. Forms for Exposed Finish Concrete: Construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- G. Form Ties and Spreaders: Standard metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete faces that will be exposed to view, painted, damp proofed or waterproofed. Inner tie rod shall be left in concrete when forms are removed. Wire ties or wood spreaders will not be permitted. Form ties and spreaders shall leave a hole not larger than 7/8-inch nor less than 1/2-inch in diameter in the concrete surface.
- H. Design, erect, support, brace, and maintain formwork so it will safely support vertical and lateral loads which might be applied until such loads can be supported safely by concrete structure.
- I. Construct forms to the exact sizes, shapes, lines, and dimensions shown, and as required to

obtain accurate alignment, location, grades, and level and plumb work in the finished structure. All exposed edges shall be chamfered with triangular fillets ½-inch by ½-inch.

- J. Form Coatings: Form coating and bond breaking materials shall be non-staining and completely compatible with finish materials and other surface treatment materials to be used.

## **2.02 VAPOR BARRIER:**

Under all floor slabs to receive carpet, wood, sheet flooring materials, rubber or other moisture sensitive topping, install a vapor barrier of 15 mil polyolefin sheeting with a minimum puncture resistance of 4,000 grams. VaporBlock15 by Raven Industries, Stego Wrap 15-Mil by Stego Industries, LLC, Perminator by WR Meadows or approved equal. Lap joints 6”.

## **2.03 REINFORCEMENT:**

A. Comply with the following as minimums:

1. Bars: ASTM A615/A615M, Grade 60 or ASTM A706 unless otherwise noted. Use deformed bars for No. 3 and larger.
2. Bending: ACI 318.
3. Tie wires and spirals: ASTM A82.
4. Reinforcement supports:
  - a. At reinforcing placed over sand or earth, use precast concrete cubes.
  - b. At reinforcing placed over forms, provide supports with legs which are hot dip galvanized, stainless steel or plastic protected.
5. Mechanical Bar Splice: Xtender by Headed Reinforcement Corp. or equal to develop a minimum of 125% of yield strength of bar.

B. Fabricate steel reinforcement in accordance with the details indicated. Where specific details are not indicated or noted, comply with the applicable requirements of CCR Title 24, Chapter 19, ACI 318, Section 7 and ACI SP-66(04). Reinforcing steel shall be cleaned, fabricated, placed, tied and supported in accordance with ACI 301 and ACI 315.

C. Do not use reinforcement having any of the following defects:

1. Bar lengths, depths, or bends exceeding the specified fabrication tolerances.
2. Bends or kinks not indicated on the Drawings or required for this Work.
3. Bars with cross-section reduced due to excessive rust or other caused.

## **2.04 CONCRETE:**

A. Portland Cement: ASTM C150, type II, low alkali.

B. Regular Weight Concrete Aggregates: ACI 318: 3.3.2 as modified by CCR Title 24 Part 2, Sec. 1903A.6.

1. Fine Aggregate: Washed clean, uniformly screen graded, and containing not more than 2 percent by weight of deleterious materials such as shale, schist, alkali, clay, lumps, earth, loam, mica, or similar materials. Uniformly grade fine aggregate from fine to coarse.

2. Coarse Aggregate: Clean, hard, crushed rock or washed gravel, free from organic materials or soft or friable materials, containing not more than 2 percent by weight of shale or cherty material and not more than 15 percent by weight of elongated fragments.
- C. Fly ash and natural pozzolans used in concrete: Mixes utilizing fly ash or natural pozzolans shall be per CCR, Title 24, Part 2, Section 1903.5.
  - D. Water: Clean and potable.
  - E. Admixtures: ACI 318: 3.6, of a type that increases workability and reduces water demand of concrete, but will not increase shrinkage. Admixture shall be subject to acceptance by the Architect and Division of the State Architect as to type and amount used. Admixtures shall contain not more than one percent chloride ions.
  - F. Provide concrete with the compressive strengths shown on the Drawings. When such strengths are not shown on the Drawings, provide the following as minimums:
    1. Concrete Foundations, Pads and Walls: 3000 psi
    2. Slabs on Grade: 3000 psi
  - G. Surface curing treatment: Curing Compound, ASTM C 309, liquid membrane forming, with fugitive dye for identification. Compound shall be compatible with finishes to be applied to concrete. Curing Compound and areas receiving it are subject to acceptance by the Architect. Where a concrete sealer is scheduled on the drawings, use sealer material specified as the curing compound.
  - H. Vapor Control Sealer: Water based, resin compound containing not less than 36 percent solids, designed to cure, seal and restrict water vapor emission for interior slabs to receive resilient, carpet, wood, rubber and sheet flooring products. Flooring products shall be warranted for a period of 15 years warranty. Acceptable products:
    - Bostik; D250
    - Diamond Stone; MTP
    - Synthetics International; Syn10
  - I. Clear Sealer Hardener: For interior slabs to remain exposed. Install a colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 pounds of fluosilicates per gallon. Acceptable products or equal:
    - Nox-Crete Chemicals Inc.; Harbeton
    - Sonneborn Building Products: Lapidolith
    - Protex Industries; Lithoplate

## **PART 3 EXECUTION**

### **3.01 SURFACE CONDITIONS**

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

### **3.02 REINFORCING**

- A. Comply with the drawings and applicable requirements of the CCR Title 24, Part 2 and ACI 318, as well as the specified standards, for details and methods of reinforcing placement and supports.
1. Clean reinforcement and remove loose dust and mill scale, earth, and other materials which reduce bond or destroy bond with concrete.
  2. Position, support, and secure reinforcement against displacement by forms, construction, and the placement operations.
  3. Place reinforcement to obtain the required coverages for concrete protection.
    - a. Where concrete is deposited against ground 3"
    - b. Concrete in forms exposed to earth or weather 2"
  4. The clear spacing between parallel bars shall be not less than 1-1/2 times the normal diameter of the maximum size aggregate, and in no case less than 1-1/2 inches, except at splices which may be wired together.
  5. Unless otherwise shown on the Drawings, or required by the above referenced codes, lap bars 24 inches minimum.
  6. Do not bend or straighten reinforcing in any manner that will injure the material.
  7. Install splices for reinforcing bars in accordance with drawings and ACI 318. Stagger splices in adjacent bars 5' – 0".

### **3.03 EMBEDDED ITEMS**

- A. Do not embed piping, other than electrical conduit, in structural concrete.
1. Locate conduit to maintain maximum strength of the structure.
  2. Increase the thickness of the concrete if the outside diameter of the conduit exceeds 30% of the thickness of the concrete.
- B. Set bolts, inserts, and other required items in concrete accurately secured so they will not be displaced, and in precise locations needed.

### **3.04 SOURCE QUALITY CONTROL**

General: Submit mill tests and manufacturer's certification of compliance with ASTM Specifications to the Inspector in lieu of testing of cement and aggregate analysis.

### **3.05 FIELD QUALITY CONTROL**

- A. Contractor shall examine placement of all reinforcement and embedded items prior to inspection by Owner's Testing Agency to ensure the proper clearances have been maintained and that all reinforcement and inserts are firmly tied to resist displacement.

- B. Contractor shall notify the Owner's Inspector at least 24 hours ahead of each concrete pour, and no concrete shall be placed until all reinforcing steel has been installed and approved by the Inspector. All reinforcing shall be complete in every way by the end of the working day prior to concrete placing. Testing and Inspections are specified in Section 01 45 33.
- C. The Owner's Testing Agency will inspect
  - 1. In-place reinforcing steel
  - 2. Field welding of reinforcing steel
- D. Contractor shall notify the Architect two working days in advance of concrete placement.

### **3.06 MIXING**

All concrete shall be ready-mixed concrete and shall be mixed and delivered in accordance with the requirements of "Specifications for Ready-Mixed Concrete", ASTM C94. In the event concrete is mixed at a central batching plant, the delivery shall be arranged so that intervals between batches are kept at a minimum, and in any event not more than thirty (30) minutes. Trucks shall be in first class condition and kept in constant rotation during delivery. No water shall be added during transit or at the job without specific approval of the Architect. Concrete shall be placed within 90 minutes after addition of water and admixtures.

### **3.07 PLACING CONCRETE**

#### **A. Preparation**

##### **1. Subgrade Preparations:**

- a. Before concrete floor slabs on grade are poured, place vapor barrier over prepared subgrade, up footings and columns and lap all joints not less than 6 inches. Seal all penetrations and pipes in accordance with manufactures instructions. Repair punctures, holes and damage prior to concrete placement using 4" wide pressure sensitive tape. Pour concrete directly on the vapor barrier surface without the use of sand in accordance with ACI 302.R1 flow chart.
- b. All sleeves, inserts, anchors and embedded items required for adjoining work or for its support shall be placed prior to concreting. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts and anchor bolt slots shall be filled temporarily with a readily removable material to prevent entry of concrete into the voids.

2. Remove foreign matter accumulated in the forms.

3. Rigidly close openings left in the formwork.

4. Wet wood forms sufficiently to tighten up cracks. Wet other material sufficiently to maintain workability of the concrete.

5. Use only clean tools.

#### **B. Conveying**

- 1. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic.

2. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to re-handling and flowing.
  3. Do not use concrete which becomes non-plastic and unworkable, or does not meet required quality control limits, or has been contaminated by foreign materials.
  4. Remove rejected concrete from the job site.
- C. Placing Concrete in Forms
1. Deposit concrete in horizontal layers not deeper than 24", and avoid inclined construction joints.
  2. Remove temporary spreaders in forms when concrete has reached the elevation of the spreaders.
- D. Placing Concrete Slabs
1. At interior slabs with moisture sensitive toppings, place concrete directly on vapor barrier surface without the use of sand in accordance with ACI 302.R1 flow chart.
  2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
  3. Bring slab surfaces to the correct level with straightedge and strike off.
  4. Use bullfloats or darbies to smooth the surface, leaving the surface free from bumps and hollows.
  5. Do not sprinkle water on the plastic surface. Do not disturb the slab surface prior to start of finishing operations.
- E. Grouting Column Bases:
1. The grout shall be mixed and placed in strict accordance with manufacturer's instructions.
  2. Care shall be taken in the grouting to ensure that there is full bearing between the base plates and the grout.

### **3.08 CONSOLIDATION**

- A. Consolidate each layer of concrete immediately after placing, by use of internal concrete vibrators supplemented by hand and spading, rodding, or tamping.
- B. Do not vibrate forms or reinforcement.
- C. Do not use vibrators to transport concrete inside the forms.

### **3.09 JOINTS**

- A. Construction Joints:
1. Do not use horizontal construction joints except as may be shown on the Drawings.
  2. The surfaces of all concrete at all joints shall be thoroughly cleaned and all laitance removed by sandblasting.

3. Concrete surfaces at designated joints shall be roughened to ¼" relief with roto hammer or similar method.
4. Moisten all joints immediately prior to placement of concrete.

**B. Expansion Joints:**

1. Do not permit reinforcement or other embedded metal items that are being bonded with concrete (except dowels in floors bonded on only one side of the joints) to extend continuously through any expansion joint.
2. Fill expansion joints full depth with expansion joint material approved by the Architect.

**3.10 CONCRETE FINISHING**

- A. Except as may be shown otherwise on the Drawings, provide the following finishes at the indicated locations.
1. Scratch Finish: Apply to monolithic slab surfaces that are to receive concrete floor topping or mortar setting bed.
  2. Float Finish: Apply to monolithic slab surfaces that are to receive trowel finish and other finishes specified hereinafter, and to slab surfaces which are to be covered with insulation.
  3. Trowel Finish: Apply to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and to slab surfaces that are to be covered with resilient flooring, carpeting, paint, wood, rubber or other thin-film finish coating system. Burnished and over finished surfaces which inhibit bonding of products to concrete shall be sanded or cleaned to expose absorbent concrete by lightly shot blasting or diamond grinding to remove concrete burnished surfaces.
- B. Concrete Vapor Sealer: All concrete floors not indicated in the schedule to receive other finish shall receive sealer specified herein.
- C. Chemical Hardener: At interior concrete floors to remain exposed, damp cure concrete, do not cure with curing compound. Apply hardener using 3 coats allowing 24 hours between coats. Apply first coat at 1/3 strength, second coat at 1/2 strength and final coat at 2/3 strength. Use manufacturer's recommended application rates. After final coat is dry, remove surplus hardener by scrubbing and mopping with water.

**3.11 DEFECTIVE WORK**

- A. Work considered to be defective may be ordered to be replaced, in which case the Contractor shall remove the defective work at his expense. Work considered to be defective shall include, but not be limited to, the following:
1. Concrete in which defective or inadequate reinforcing steel has been placed.
  2. Concrete incorrectly formed, or not conforming to details and dimensions on the drawings or with the intent of these documents or concrete the surfaces of which are out of plumb or level.
  3. Concrete below specified strength.

4. Concrete containing wood, cloth or other foreign matter, rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the drawings.

**3.12 CORRECTION OF DEFECTIVE WORK**

- A. The Contractor shall, at his expense, make all such corrections as directed by the engineer.
- B. Concrete work containing rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the drawings shall be chipped out until all unconsolidated material is removed.

**END OF SECTION**



**SECTION 04 20 00**  
**UNIT MASONRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 05 50 00 - Metal Fabrications: fabricated steel items.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- D. Section 07 84 00 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- E. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

**1.03 REFERENCE STANDARDS**

- A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
  - 1. Use 2014 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- C. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.
- D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
  - 1. Use 2004 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- E. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
  - 1. Use 2012 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- H. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- I. 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.

- B. Product Data: Provide data for masonry units and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- D. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- E. Installer's Qualification Statement.
- F. Maintenance Materials: Furnish the following for District's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

### **1.06 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.
- 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 CONCRETE MASONRY UNITS**

- A. Acceptable Manufacturers:
  - 1. Angeles Block Co., Inc.: [www.angelusblock.com](http://www.angelusblock.com).
  - 2. Orco Block Co.: [www.orco.com](http://www.orco.com).
  - 3. RCP Block and Brick: [www.rcpblock.com](http://www.rcpblock.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 x 8 inches or as indicated and nominal depths as indicated on the Drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
3. Load-Bearing Units: ASTM C90, medium weight.
  - a. Hollow block, as indicated.
  - b. Exposed Faces: Manufacturer's standard color and texture where indicated.
  - c. Pattern: As indicated on Drawings.
    - 1) CMU-1: Precision; Color: As indicated on Drawings
  - d. Non-Loadbearing Units: ASTM C129.
    - 1) Hollow block, as indicated.
    - 2) Medium weight.
  - e. Solid Cap Unit: Nominal unit size, texture and color to match adjacent wall, unless specified otherwise.

## **2.02 MORTAR AND GROUT MATERIALS**

- A. All materials to conform to CBC, Section 2103A.2 and 2103A.3.
- B. Masonry Cement: ASTM C91/C91M, Type S.
- C. Portland Cement: ASTM C150/C150M, Type I.
  1. Not more than 0.60 percent alkali.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Mortar Aggregate: ASTM C 144, except for joints less than 1/4-inch use aggregate graded with 100 percent passing the No. 16 sieve.
- F. Grout Aggregate: ASTM C404.
- G. Water: Clean and potable.

## **2.03 REINFORCEMENT AND ANCHORAGE**

- A. Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on drawings; uncoated finish.

## **2.04 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](http://www.blok-lok.com/#sle).
    - b. Dur-O-Wal: [www.dur-o-wal.com](http://www.dur-o-wal.com).
    - c. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com).
    - d. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle).
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
- 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](http://www.h-b.com).
  - b. WIRE-BOND: [www.wirebond.com/#sle](http://www.wirebond.com/#sle).
  - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. 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](http://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. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.
- D. 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.
- E. 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.
- F. 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.
- G. 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 TMS 402/602 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. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 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 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.

### **3.07 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.

### **3.08 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.

### **3.09 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.

### **3.10 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.

### **3.11 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Inspection and Core Tests shall be per DSA IR 21-2.13 and 2105A.4.

### **3.12 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.

### **3.13 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.

### **3.14 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 (CMU).
  2. Mortar and grout.
  3. Reinforcing steel.
  4. Control joint materials.
  5. Masonry joint reinforcement.
  6. Ties and anchors.
  7. Embedded flashing.
  8. Miscellaneous masonry accessories.

##### 1.02 SUBMITTALS

- A. Certificates of compliance with respective ASTM standards shall be submitted on all products specified herein.
1. Concrete masonry units.
  2. Spec Mix preblended mortar: Include test report or batch data for verification of proportions of materials.
  3. Grout: Include mix design for verification of proportions of materials.
  4. Steel reinforcing bars.
  5. Preformed control joint gaskets.
- B. Samples for Verification: For each type and color of the following:
1. Exposed concrete masonry units.
  2. Mortar, for color selection or confirmation.

##### 1.03 QUALITY ASSURANCE

- A. Preconstruction Testing.
1. Owner will select a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.
  2. The compressive strength of masonry shall be determined based on strength of the unit and type of mortar specified (Unit Strength Method) per ACI 530.1/ASCE 6/TMS 602 Table 2).
    - a. Concrete Masonry Units: Test per ASTM C 140.
    - b. Grout: Test per ASTM C 1019.

3. Mortar and grout tests: At beginning of work, sample mortar and grout on three successive working days per CBC Section 2105A.3.
- B. Sample Panels: Construct an approximate long by panel for representation of completed masonry, joint tooling, design details, and workmanship. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. All materials of this section shall be protected to maintain quality and physical requirements.
- B. All masonry units shall be stored on the jobsite so that they are protected from rain, stored off-ground and kept clean from contamination. Prevent units from being otherwise wetted.
- C. Store Spec Mix preblended mortar mix in manufacturer's original, unopened, undamaged containers with identification labels intact, covered and protected from weather, or in a Spec Mix dispensing silo.

#### **1.05 FIELD CONDITIONS**

- A. Securely cover tops of all unsheltered walls and partially completed walls when work is not in progress.
- B. Cold-weather and hot-weather masonry construction is addressed in IBC Sections 2104.3 and 2104.4, respectively. Include and modify below as necessary.
- C. Cold-weather procedures when ambient temperature falls below 40°F (4°C) or the temperature of masonry units is below 40°F (4°C):
  1. Wet or frozen units shall not be laid.
  2. Implement cold weather construction procedures in accordance with IBC Section 2104.3.
- D. Hot-weather procedures when ambient temperature exceeds 100°F (38°C), or exceeds 90°F(32°C) with a wind velocity greater than 8 mph:
  1. Implement hot weather construction procedures in accordance with IBC Section 2104.4.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURER**

- A. Concrete masonry units.
  1. Angelus Block Co., Inc.
    - a. Sun Valley, CA (818) 767-8576
    - b. Orange, CA (714) 637-8594
    - c. Fontana, CA (909) 350-0244
    - d. Gardena, CA (310) 323-8841
    - e. Oxnard, CA (805) 485-1137
    - f. Indio, CA (760) 347-3245

- B. Preblended mortar.
  - 1. Spec Mix Preblended Mortar Mix, by E-Z Mix, Inc.

## **2.02 MASONRY PERFORMANCE REQUIREMENTS**

- A. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than 2,000 psi  $f'_m$ .
- B. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than the  $f'_m$  as indicated.

## **2.03 CONCRETE MASONRY UNITS**

- A. Concrete Masonry Units: ASTM C 90, Net area compressive strength: 2,000 psi.
  - 1. Weight Classification: Medium weight unless otherwise indicated.
  - 2. Color(s) and texture(s):
    - a. Grey

## **2.04 MORTAR AND GROUT MATERIALS**

- A. Spec Mix Masonry Mortar preblended factory mix: ASTM C 270, proportions.
  - 1. Portland cement: ASTM C 150
  - 2. Hydrated lime: ASTM C 207
  - 3. Aggregate for mortar: ASTM C 144.
  - 4. 28-day strength: 2,000 psi minimum.
- B. Grout:
  - 1. Portland cement: ASTM C 150
  - 2. Aggregate: ASTM C 404.
  - 3. Fly ash: ASTM C 618.
  - 4. 28-day strength: 2,000 psi minimum.
- C. Water: Potable.
- D. Admixtures:
  - 1. The use of admixtures shall not be permitted except as specified herein, or as approved by the Architect or Engineer of Record and the Building Official.
  - 2. PRE-MIX Products Grout Additive manufactured by E-Z Mix, Inc. Use per manufacturer's specifications.

## **2.05 REINFORCEMENT**

- A. Steel Reinforcing Bars: ASTM A 615, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951.
  - 1. Masonry joint reinforcement used in exterior walls shall be hot-dipped galvanized.

## **2.06 TIES AND ANCHORS**

- A. Metal ties and anchors shall meet the requirements of CBC Section 2103.13.

## **2.07 MISCELLANEOUS MASONRY ACCESSORIES**

- A. PVC Preformed Control-Joint Gaskets: per ASTM D 2287, Type PVC.
- B. Rubber Preformed Control-Joint Gaskets: per ASTM D 2000, Designation M2AA-805.

## **2.08 MORTAR AND GROUT MIXES**

- A. Type S Spec Mix Preblended, Dry Mortar Mix.
  - 1. Complies with ASTM C 270 Proportion Specification.
  - 2. Natural gray color.
- B. Grout for Unit Masonry: per ASTM C 476.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Prior to the start of masonry installation, verify all conditions pertinent to the performance of work in this Section are acceptable.
  - 1. Foundation shall be level and at correct grade such that the initial bed joint shall not be less than 1/4 inch nor more than 3/4 inch.
  - 2. Verify that reinforcing dowels are properly placed.
- B. Masonry work shall not proceed until unsatisfactory conditions have been corrected or cleared by the governing authority.

### **3.02 INSTALLATION**

- A. Cut units as required to fit; use motor-driven masonry saw. Install cut units with cut surfaces edges concealed as much as possible.
- B. Lay dry units only, unless otherwise approved.
- C. Select and arrange units for exposed masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- D. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602.

### **3.03 LAYING MASONRY WALLS**

- A. All masonry shall be laid true, level, plumb, and in accordance with the drawings.
- B. Masonry shall be laid in running bond unless otherwise indicated.
- C. Exposed masonry shall be laid in unless otherwise indicated.
- D. Concealed masonry with shall be laid in running bond unless otherwise indicated.
- E. Install built-in items specified in this and other Sections as work progresses. Solid grout all spaces around built-in items unless otherwise noted on the drawings.

### **3.04 MORTAR BEDDING AND JOINTING**

- A. Lay hollow units with head and bed joints filled with mortar for the thickness of the face shell.

- B. Lay solid units with full head and bed joints. Do not fill head joints by slushing with mortar. Bed joints shall not be furrowed deep enough to produce voids.
- C. All mortar joints on exposed walls shall be concave, unless otherwise indicated, and struck to produce a dense, slightly concave surface well bonded to the surface of the masonry unit.
- D. Cut joints flush for masonry walls to receive plaster, unless otherwise indicated.
- E. Thickness of bed joints shall not exceed 5/8 inch.

### **3.05 MASONRY JOINT REINFORCEMENT**

- A. Embed joint reinforcement with minimum 5/8 inch cover to exposed face, and 1/2 inch elsewhere.

### **3.06 CONTROL AND EXPANSION JOINTS**

- A. Construct control joints as detailed in the drawings as masonry progresses.
  - 1. Install preformed control-joint gaskets designed to fit standard sash block.

### **3.07 INSTALLATION OF REINFORCING STEEL**

- A. Place reinforcement as detailed on the drawings.
  - 1. Maintain clear distances between reinforcement and masonry, and maintain placement tolerances in compliance with requirements in ACI 530.1/ASCE 6/TMS 602.

### **3.08 GROUTING: Either High Lift or low lift systems may be used.**

- A. Low Lift System:
  - 1. Comply with CBC, Sec. 2104A.1.3.1.1.1.1.
  - 2. This system includes placing reinforcing steel before or during construction of wall, and pouring grout in lifts not exceeding 4 feet, unless cleanouts are provided as specified under High Lift Grout System.
  - 3. Keep mortar out of grout spaces.
  - 4. Place reinforcing steel accurately according to drawings and notes thereon. Erect vertical reinforcing before laying masonry and brace firmly in position. Use frames or other suitable devices to prevent movement or jarring while placing masonry or grout. Place horizontal steel as construction progresses. Lap steel at least 48 bar diameter. Extend steel through points of stoppage to provide required lap. Horizontal steel may be wired temporarily above required position and tagged to indicate its location and vertically marked indicators maintained showing required location of horizontal bars.
  - 5. After completion of grouting if doubt exists whether or not steel has been properly placed, use drill to locate steel, or open masonry as required by Architect. Make repairs as directed.
  - 6. Install anchor bolts with the tail of bolt hooked over a continuous horizontal bar or an added #4 horizontal bar. Dry pack around void where anchor bolt penetrates masonry face shell.

7. Fill masonry cores with grout and immediately consolidate each cell with a mechanical vibrator having 3/4 inch head and operating at 5000 RPM submerged.
  8. Pour grout to 1½ inches below top of masonry unit except at finish course. Immediately remove grout or mortar on exposed faces.
  9. Form construction joints by stopping grout 1½ inches below top of wall. If construction is to be stopped for more than 1 hour, form construction joint with block top surface free of mortar or grout.
  10. At jambs use temporary wood dams where necessary to contain mortar and grout.
- B. High Lift Grout System: Construct high lift concrete block masonry construction to CBC, Sec. 2104A.1.3.1.1.1.2. and DSA IR 21-2.13, and with the following requirements.
1. High lift grouting shall not be used on walls that do not conform with DSA IR 21-2.13. The Walls Shown on these Details shall not be grouted by high lift grouting:
    - a. Detail 8 on Sheet S402.
  2. Provide open end concrete masonry units.
  3. Where horizontal reinforcing occurs, provide bond beam units with 3-inch high by 3-inch wide vertical openings at all cross webs.
  4. Provide cleanout openings for cells at the bottom of each pour. make openings before the start of laying, of sufficient size and location to allow flushing away mortar droppings and debris. Cleanout openings may be cut in the blocks or formed in the foundation.
  5. After the laying of masonry units is completed, the cells cleaned, the reinforcing positioned, and inspection completed, close the cleanouts by inserting face shells of masonry units or covering the opening with forms. Face shell plugs shall have a 2 day minimum curing time and shall be adequately braced to resist the pressure of the fluid grout.
  6. Accurately place reinforcing steel inserts and bolts in strict accordance with the Contract Drawings. Hold both horizontal and vertical reinforcing in position by wire ties or spacing devices near ends and at intervals not exceeding 160 diameters of the reinforcement.
  7. Place the horizontal reinforcing as the construction progresses. Thread the vertical reinforcing into position after the completion of laying if adequate positioning devices and clearances are provided to permit such placement. Otherwise, erect vertical reinforcement ahead of masonry work.
  8. Use bond beam units to facilitate the horizontal flow of grout and at all horizontal bars to provide a minimum opening at cross webs 1½ inches high for the width of the cell.
  9. Fill head and be joints solidly with mortar. Take care in placing the mortar to keep a minimum of droppings from falling into the block cells.
  10. When adequate cross webs between face shells are not provided, install ties of heavy gage wire (minimum of #9 galvanized) embedded in the horizontal mortar joints across continuous vertical joints or between face shells to prevent "blowouts" from hydrostatic pressure of the fluid grout. External ties or braces may also be used for this purpose.

11. Adequately brace undergrouted walls against wind and other lateral forces during construction.
12. Remove mortar droppings and overhangs from the foundation or bearing surface, cell walls, and reinforcing. Acceptable methods are as follows:
  - a. Hosing with a high pressure jet steam at least twice a day (at midday and quitting time).
  - b. Providing a 1 to 2 inch blanket to dry sand over the exposed surface of the foundation, dislodging hardened mortar from the cell walls and reinforcing using a pole or rod, and removing the mortar debris with the same high pressure jet stream.
13. In the high lift grouting method, intermediate horizontal construction joints are not permitted. Plan construction for one continuous pour of grout to the top of the high lift portion of the wall in 4 foot layers or lifts in the same working day. Should a blowout, a breakdown in equipment, or any other emergency occur, cease the grouting operation. Use procedures as directed by the Architect.
14. To prevent "blowouts" do not pour grout until the mortar has set and cured. However, grout the walls as soon as possible thereafter to reduce shrinkage cracking of the vertical joints. Cleanout closures, reinforcing, bolts and embedded connection items shall be in position before grouting is started. All cells shall be filled with grout.
15. Handle grout from the mixer to the point of deposit in the grout space as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry unit surfaces not being immediately encased in the grout lift. Depending upon weather condition and absorption rates of the masonry units, the lift heights and waiting periods may be varied. Under normal weather conditions, with typical masonry units, limit the individual lifts of grout to 4 feet in height with a waiting period between lifts of 30 to 60 minutes.
16. Place the first lift of grout to a uniform height within the pour section and vibrate thoroughly to fill all voids. This first vibration shall follow the pouring of the grout by not more than 10 feet. Vibrate or consolidate with approved mechanical vibrators.
17. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, pour succeeding lift and vibrate alternate cells by extending vibrator 12 inches to 18 inches into the preceding lift to reconsolidate the preceding lift and close plastic shrinkage cracks or separations from the cell walls.
18. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding lift, reconsolidate each lift by reworking with the vibrator as soon as the grout has taken its settlement shrinkage.
19. Repeat the waiting, pouring and reconsolidating steps until the top of the pour is reached. Also reconsolidate the top lift after the required waiting period and fill space left by settlement shrinkage with grout.

### **3.09 FIELD QUALITY CONTROL**

- A. Inspection tasks and frequency shall be performed in accordance with the Statement of Special Inspections.
- B. Unless indicated otherwise, perform one set of tests for each 5000 sq. ft. of wall area or portion thereof.
- C. Concrete Masonry Units: test per ASTM C 140.
- D. Grout: Test per ASTM C 1019.
- E. Prism Test: For each type of construction indicated, construct and test three prisms per ASTM C 1314 at 28 days.
- F. Masonry Core Test: Core and test per CBC Section 2105A.4 from locations selected by the Design Professional.
- G. Mortar and grout tests: Sample mortar and grout at minimum one-week intervals per CBC Section 2105A.3.

### **3.10 POINTING, AND CLEANING**

- A. Point and tool holes in mortar joints to produce a uniform, tight joint.
- B. During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs.
  - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
  - 2. For burnished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Clean exposed cmu walls with a light sandblast. All non-masonry work near the area to be sandblasted shall be covered or protected before the sandblasting starts. Care shall be taken to avoid contamination to areas that are not to be sandblasted.
    - a. Glazed, burnished, or pre-finished masonry units, shall be protected from sandblast operations.
- D. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site.

**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 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 45 33 - Code-Required Special Inspections and Procedures: Test reporting.
- C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.
- D. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- E. Section 05 50 00 - Metal Fabrications.
- G. Division 26 - Electrical: Mounting of equipment and components.
- H. 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; 2017.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
- 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; 2018.
- E. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2015).

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – 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 1 and Section 01 45 33 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.
  - 1. Substitution of structural anchors requires structural calculations and DSA approval.

### **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 1 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. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:

1. Substitutions: See Section 01 60 00 - Product Requirements.

## **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: 2 Type B7 with zinc plating in accordance with 3, 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 1, 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 60 00 - Product Requirements.
- E. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:
  1. Substitutions: See Section 01 60 00 - Product Requirements.

## **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 1, 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](http://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](http://www.hilti.com).
  3. Substitutions: See Section 01 60 00 - Product Requirements.

## 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](http://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 33 - Code-Required Special Inspections and Procedures.
- 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 1909.2.7.
    - c. Verify anchor type, anchor dimensions, hole dimensions, anchor spacing, edge distances, anchor embedment and adherence to the manufacturer's published installation instructions.
    - d. 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

#### PART 1 GENERAL

##### 1.01 SUMMARY

The work includes the furnishing and installing of all structural steel work, anchors, bolts, and fastenings, and specialty items, shown and noted on the drawings and as necessary to complete the work. The General Conditions and Division 1 apply to this section as fully as if repeated herein.

##### 1.02 CODES

A. Except as modified by the requirements specified herein or details on the drawings, structural steel work shall conform to the 2019 California Code of Regulations, Title 24, Part 2, California Building Code (CBC), Chapter 22.

##### 1.03 REFERENCES

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

- A. American Institute of Steel Construction (AISC).
- B. American Iron and Steel Institute (AISI).
- C. American Society for Testing and Materials (ASTM).
- D. American Welding Society (AWS).
- E. Steel Structures Painting Council (SSPC)

##### 1.04 SUBMITTALS

- A. Submittal procedures and quantities are specified in Section 01 33 00.
- B. Shop Drawings: Submit fully detailed shop drawings of all metalwork, giving sizes, details of fabrication and construction, methods of assembly, and locations of hardware, anchors, and all miscellaneous work for review.
  - 1. Drawings shall include all shop and erection details, including cuts, copes, connections, holes, bolts and welds. All welds, both shop and field, shall be indicated by standard welding symbols in the American Welding Society Standard Code for Arc and Gas Welding in Building Construction. Drawings shall show the size, length and type of each weld.
  - 2. Contractor shall be responsible for all fabrication and for correct fitting of structural members shown on shop drawings. No materials shall be fabricated or delivered to the site until the shop drawings have been reviewed and returned to the Contractor.



C. Product Data:

1. Submit manufacturer's certification for bolts, nuts, washers and filler material for welding.
2. Submit mill test certificates for mill order steel which can be identified readily by means of heat or melt numbers marked at the mill. Such need not be tested as specified in Section 01 45 33.

**1.05 FIELD MEASUREMENTS AND TEMPLATES**

Contractor shall secure all field measurements required for proper and adequate fabrication and installation of the work covered by this section. Exact measurements are the contractor's responsibility. Furnish steel templates for exact location of items to be embedded in concrete and any setting instructions required for all installation work.

**1.06 DELIVERY AND STORAGE OF MATERIALS**

Deliver material in time to insure uninterrupted progress of the work. Materials shall be stored in a manner to preclude damage and permit ready access for inspection and identification of each shipment. Steel materials, either plain or fabricated, shall be stored above the ground upon platforms, pallets, skids, or other supports. Materials shall be kept free from dirt, grease, and other foreign matter, and shall be protected from corrosion. Material showing evidence of damage will be rejected and shall be immediately removed from the work.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Materials and design shall conform with the requirements of CBC, Sec. 2203 and 2205.
- B. Structural Steel: All structural steel shall be standard structural sections, conforming to ASTM A36.
- C. Wide Flange Sections: Wide flange sections shall conform to ASTM A992.
- D. Steel Pipe: Galvanized steel pipe shall conform to ASTM A53, Grade B.
- E. Steel Tube: Tube shall conform to ASTM A500, Grade B Fy = 46 KSI.
- F. Anchors, Bolts, and Fastenings: Bolts and nuts shall conform to ASTM A307, Grade A.
- G. Electrodes: Arc-welding electrodes shall conform to AWS A5.1 or A5.5 E70XX
- H. Shop primer for steel, other than galvanized, shall meet Federal Specification TT-P-86, TT-P-(zinc chromate).
- I. Galvanized hardware shall conform to ASTM A153, Class C.
- J. Treatment for damaged galvanized surfaces shall be Galvalloy, Galvicon or Drygalv.

- K. Miscellaneous angles and plates not indicated or specified otherwise shall be not less than 1/4" thick.
- L. Bars: Bars for locations shown shall be steel bars conforming to ASTM A36, as required of the sizes and shapes shown of the drawings.
- M. Pipe Sleeves: Pipe sleeves through concrete walls and footings shall be standard weight, wrought iron, mild steel, or cast-iron sleeves with not less than 1/4 inch space all around between the sleeve and pipe.
- N.

## **2.02 MISCELLANEOUS ITEMS**

Miscellaneous metal items and their related components are not necessarily individually described. The most important and those requiring detail description are mentioned. Miscellaneous items not mentioned or described shall be furnished and installed in accordance with the intent of the drawings and specifications and as required to complete the work.

## **PART 3 EXECUTION**

### **3.01 GENERAL REQUIREMENTS**

- A. General: All steel work shall conform with the applicable requirements of the hereinbefore referenced "Codes and Standards". All details shown are typical. Similar details apply to similar conditions. Drawings shall be checked for dimensions, elevation, size and locations of all installations. All dimensions shall be verified at the job. Built-in or cast-in items shall be supplied in ample time for incorporation in the work. Include all reinforcing angles, plates, straps, brackets, hangers, clips, lugs, holes, shims, etc., as shown or required for erection of steel work and as required to complete the work as shown on the drawings.

### **3.02 WELDED CONNECTIONS**

- A. All welders shall be certified qualified welders.
- B. Welded connections shall be made in strict accordance with AWS D1.1. All welding shall be done in the shop unless otherwise shown or specified.
- C. All welds exposed in the finished work shall be ground and dressed smooth and so that the shape and profile of the item welded is preserved.

### **3.03 FABRICATION**

- A. Materials shall be fabricated and assembled in the shop to the greatest extent possible. Shearing, flame cutting, and chipping shall be done carefully and accurately. Coordinate all connection details to concrete. Verify all lines, levels, and dimensions, where possible, just prior to commencing fabrication of connection details. Correct any work that does not fit. Schedule and coordinate work under this section with that specified elsewhere in order to produce a workmanlike installation. When not otherwise shown or specified, comply with all

applicable requirements of AISC "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings". Finished surfaces of all exposed members shall be smooth and free of any markings, burrs, or other defects.

- B. Connections shall be bolted or welded as indicated. One-sided or other types of eccentric connections will not be permitted unless shown in detail and approved on the shop drawings.
- C. Holes shall be cut, drilled, or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be provided in members to permit connecting the work of other trades.

### **3.04 SHOP PAINTING**

- A. General: Shop paint structural steel except galvanized members or those members or portions of to be embedded in concrete or mortar. On embedded steel which is partially exposed, paint the exposed portions and the initial 2 inches of embedded areas only. Do not paint surfaces to be welded or high strength bolted with friction-type connections. Do not paint surfaces which are scheduled to receive sprayed-on fireproofing.
- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove rust, loose mill scale and spatter, slag or flux deposits using power tool cleaning in accordance with SSPC SP-3.
- C. Painting: Immediately after surface preparation, apply shop primer in accordance with manufacturer's instruction and at a rate to provide a dry film thickness of not less than 1.5 mils. Use painting methods which result in full coverage of joints, corners edges and exposed surfaces.

### **3.05 INSTALLATION**

- A. Steel items shall be installed as rapidly as the progress of other work will permit. Splices and field connections shall be made with bolts, except where welding is required or approved on the shop drawings. Fasteners shall be installed as specified hereinafter.
- B. Work shall be set accurately at the established lines and levels. Installation shall be in strict accordance with approved drawings and actual conditions, true and horizontal or perpendicular as the case may be, level and square with angles and edges parallel with related lines of the building.
- C. Anchor bolts and anchors shall be properly located and built into connecting work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.
- D. After assembly, the various members forming parts of a completed frame shall be aligned and adjusted accurately before being fastened. Tolerances shall conform to the applicable requirements of AISC " Code of Standard Practice". Contact surfaces shall be cleaned before the members are assembled.

### **3.06 GALVANIZING**

- A. All steel and ferrous metal items located on the exterior of building, or otherwise specifically shown or noted on drawings to be galvanized, shall be galvanized by hot-dip process, conforming to ASTM A123. All required hot-dip galvanizing shall be done after fabrication, in the largest sections possible, Items too large for available dip tanks shall be sprayed, by approved methods, with molten zinc to coating thickness of 3.4 mils.
- B. Weight of zinc coating per square foot of actual surface shall average not less than 2.0 ounces and no individual specimen shall show less 1.8 ounces.
- C. All shop galvanized metal work necessitating field soldering or welding which in any manner removes original galvanizing shall be restored by field cold galvanizing with "Galvaloy", "Galvicon" or "Drygalv".

**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. Ladder safety systems.

**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 09 91 13 - Exterior Painting: Paint finish.

**1.03 REFERENCE STANDARDS**

- A. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.
- B. 29 CFR 1910.23 - Ladders; current edition.
- C. 29 CFR 1910.28 - Duty to have Fall Protection and Falling Object Protection; Current Edition.
- D. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- E. AHRI 560 - Voluntary Specification for Rotary Operators in Window Applications; 2010.
- F. ALI A14.3 - Ladders - Fixed - Safety Requirements; 2014.
- G. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- H. ANSI/ASSP Z359.11 - Safety Requirements for Full Body Harnesses; 2014.
- I. ANSI/ASSP Z359.12 - Connecting Components for Personal Fall Arrest Systems; 2009.
- J. ANSI/ASSP Z359.15 - Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems; 2014.
- K. ANSI/ASSP Z359.16 - Safety Requirements for Climbing Ladder Fall Arrest Systems; 2016.
- L. 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.
- M. 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; 2018.
- N. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
  - 1. Use 2008 as indicated in 2016 CBC Referenced Standards.
- O. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

- P. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- Q. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
  - 1. Use 2012a as indicated in 2016 CBC Referenced Standards.
- R. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014, with Editorial Revision (2017).
- S. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2018.
- T. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.
  - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- U. 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; 2018a.
- V. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- W. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2018.
- X. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- Y. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2018.
- Z. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- AA. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- AB. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
  - 1. Use 2010 w/Errata as indicated in 2016 CBC Referenced Standards.
- AC. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2017.
- AD. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel; 2016.
- AE. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- AF. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- AG. SSPC-SP 10 - Near-White Blast Cleaning; 2007.
- AH. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- AI. SSPC-SP 3 - Power Tool Cleaning; 1982, with Editorial Revision (2004).
- AJ. SSPC-SP 5 - White Metal Blast Cleaning; 2007.
- AK. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

#### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. 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.
- C. Certificate: Provide documentation that ladder safety system products of this section meet or exceed cited 1, 1, 1, and 1 requirements.
- D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- E. 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. 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.
- E. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel or equal.
- F. 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, 1, 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, 1; cold-rolled, 2.
  2. For nonstructural uses: Cold-rolled, 2; hot-rolled, 1.
  3. Galvanized Sheet steel: 2, with 3, Coating Designation G90, for precoated sheet; 1 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: 1, Grade A, hexagonal head.
- F. Lag Screws and Bolts, Steel: 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](http://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. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded.
- N. 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. Bituminous Coating: High-build mineral-filled coal tar pitch coating, or a cold-applied asphalt mastic complying with 1, except containing no asbestos fibers.
  - 1. Basis of Design Product: H.B. Tnemecol Series 46-465 as manufactured by Tnemec, Inc., [www.tnemec.com](http://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.; Sealmatic Type II (Brush-on/Spray Grade): [www.wrmeadows.com](http://www.wrmeadows.com)
    - g. Substitutions: See Section 01 60 00 - Product Requirements.

Q. 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 1. 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. 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.
3. 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.
4. 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 1 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. Steel Tubing and Piping Fabrication: Unless otherwise indicated, close ends with plate stock so no exposed ends of tubing and piping. Grind all edges.
- M. 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.
- N. 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. Joist Hangers: Strap anchors, fabricated with sheet steel, 18 gage, 0.0478 inch minimum base metal thickness; galvanized finish.
- D. Ledge Angles Not Attached to Structural Framing: For support of joists; prime paint finish.
  1. Drill plates to receive anchor bolts and for grouting as required.
- E. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
- F. Enclosure Gates
  1. Fabricated steel shapes as detailed on Drawings, hot-dipped galvanized finish after fabrication, with galvanized perforated steel panel infill.
  2. Steel Face Panels for Gates:
    - a. Corrugated Panels: 18 gage galvanized steel box-rib style decking, 1-1/2 inches deep; ASC Steel Deck Division of ASC Profiles, Inc.
  3. All welded construction.
  4. 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 leaves).

5. 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.
- G. 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 LADDER SAFETY SYSTEMS

- A. Fall Arrest Anchor: Comply with 1 and 2 Subpart M.
  1. Basis of Design Product: Truss Boss Kit as manufactured by Guardian Fall Protection, or approved equal.
- B. Climbing Ladder Fall Arrest System (CLAFS): Comply with 29 CFR 1910.29, 29 CFR 1926.1053, Section 7 of ALI A14.3 and ANSI/ASSP Z359.16; climbing ladder fall arrest system allows worker to climb up and down using both hands; does not require employee continuously, hold, push, or pull any part of system while climbing.
  1. Install on new fixed ladders over 24 feet in height.
  2. Anchorage: Fixed ladder meeting requirements of 29 CFR 1910.23.
  3. Flexible Carrier: Fixed 3/8 inch diameter stainless steel wire rope lifeline with shock absorber and top, bottom and intermediate supports; meeting requirements of ANSI/ASSP Z359.16.
    - a. Provide with stainless steel extension post at top of ladder; meeting requirements of ANSI/ASSP Z359.16.
  4. Fall Arrester: Stainless steel and aluminum automatic pass-through carrier sleeve fall arrester meeting requirements of ANSI/ASSP Z359.15 and ANSI/ASSP Z359.16; compatible with carrier.
    - a. If designed to be removable from carrier, arrester removable only by at least two deliberate manual action(s) by user.
    - b. Includes an anti-inversion device to prevent installation of carrier sleeve upside down on carrier.
    - c. Carrier sleeve movement is automatic and does not require continuous manual intervention during climbing or descending.
    - d. Includes panic grab (secondary locking mechanism) feature.
  5. Manufacturers; ANSI/ASSP Z359.16 compliant:
    - a. 3M Personal Safety Division: [www.3M.com/FallProtection/#sle](http://www.3M.com/FallProtection/#sle).
    - b. MSA Safety Incorporated: [www.msasafety.com/#sle](http://www.msasafety.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Personal Fall Arrest System Components; 29 CFR 1910.140:

1. Body Support: Full body harness meeting requirements of ANSI/ASSP Z359.11; equipped with front or hip D-rings for attachment to climbing ladder fall arrest system.
2. Connecting Means: Connecting hardware, such as a locking carabiner, meeting requirements of ANSI/ASSP Z359.12; compatible with fall arrester and body support harness.
3. Manufacturers:
  - a. Honeywell International, Inc: [www.honeywell.com/#sle](http://www.honeywell.com/#sle).
  - b. 3M Personal Safety Division: [www.3M.com/FallProtection/#sle](http://www.3M.com/FallProtection/#sle).
  - c. MSA Safety Incorporated: [www.msasafety.com/#sle](http://www.msasafety.com/#sle).
  - d. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.06 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 1, 2, 8, or 3.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

## **2.07 FABRICATION TOLERANCES**

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Confirm that the ladder structure to which the ladder safety system is installed is capable of withstanding the loads applied by the system in the event of a fall.

### **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. Install ladder safety system in accordance with manufacturer's instructions.
- C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Field weld components as indicated on drawings.
- E. Perform field welding in accordance with AWS D1.1/D1.1M.
- F. Obtain approval prior to site cutting or making adjustments not scheduled.
- G. 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 1 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.
  - 1. Clean exposed areas of rust, field welds, bolted joints, and areas where primer is damaged by 1 hand tool cleaning or 2 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 07 01 50.19**  
**PREPARATION FOR RE-ROOFING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Removal of existing roofing system in preparation for a new roof membrane system.
- B. Removal of existing flashing and counterflashings.
- C. Temporary roofing protection.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 62 00 - Sheet Metal Flashing and Trim: Replacement of flashing and counterflashings.

**1.03 REFERENCE STANDARDS**

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2017).
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- C. PS 1 - Structural Plywood; 2009.
- D. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with affected mechanical and electrical work associated with roof penetrations.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
  - 1. Attendees:
    - a. Architect.
    - b. Contractor.
    - c. District.
    - d. Installer.
    - e. Roofing system manufacturer's field representative.
    - f. Inspection and Testing Agency Representatives.
  - 2. Meeting Agenda: Provide agenda to participants prior to meeting in preparation for discussions on the following:
    - a. Removal and installation schedule.
    - b. Necessary preparatory work.
    - c. Protection before, during, and after roofing system installation.
    - d. Removal of existing roofing system.
    - e. Installation of new roofing system.
    - f. Temporary roofing and daily terminations.
    - g. Transitions and connection to and with other work.

- h. Inspections and testing of installed systems.
  - 3. Attendance is mandatory at conference required in section specifying new roofing installation.
  - 4. Establish at pre-bid job walk, number of layers to be removed and reconfirm at pre-installation conference.
- C. Schedule work to coincide with commencement of installation of new roofing system.

#### **1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit for each type of material.
- C. Shop Drawings: Indicate size, configuration, and installation details.
- D. Preconstruction Test Reports.
- E. Materials Removal Company Qualification Statement.
- F. Installer's Qualification Statement.
- G. Preconstruction Testing Agency Qualification Statement.

#### **1.06 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning membrane roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Materials Removal Company Qualifications: Company specializing in performing work of type specified with at least three years of documented experience.
  - 1. Comply with EPA notification regulations prior to start of roofing removal work.
  - 2. Comply with removal and disposal regulations of local authorities having jurisdiction (AHJ).
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
  - 1. When same installer as new roofing system, comply with related requirements of section indicated for new roofing system.
- D. Preconstruction Testing: Conduct testing by an independent test agency, in accordance with provisions of Section 01 40 00 - Quality Requirements.
  - 1. Provide required testing to locate hazardous materials, such as asbestos, by licensed agency as required for project location.
- E. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

## **1.08 SCHEDULING**

- A. Schedule work to coincide with commencement of installation of new roofing system.
- B. Remove only existing roofing materials that can be replaced with new materials as the weather will permit.

## **1.09 FIELD CONDITIONS**

- A. Existing Roofing System: Built-up asphalt roofing.
- B. Do not remove existing roofing membrane when weather conditions threaten the integrity of building contents or intended continued occupancy.
- C. Maintain continuous temporary protection prior to and during installation of new roofing system.
- D. Provide notice at least three days before starting activities that will affect normal building operations.
- E. Verify that occupants have been evacuated from building areas when work on structurally impaired roof decking is scheduled to begin.

## **1.10 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

## **PART 2 PRODUCTS**

### **2.01 COMPONENTS**

- A. Refer to following sections for additional information on components relating to this work:
  - 1. Remove existing flashing and counterflashings in preparation for replacement of these materials as part of this work, refer to Section 07 62 00 for material requirements.

### **2.02 SYSTEM DESCRIPTION**

- A. Indicated Roof Areas: Remove existing roofing, perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, insulation, vapor retarder.

### **2.03 MATERIALS**

- A. Patching Materials: Provide necessary materials in accordance with requirements of existing roofing system.
- B. Temporary Roofing Protection Materials:
  - 1. Contractor's responsibility to select appropriate materials for temporary protection of roofing areas as determined necessary for this work.
  - 2. Plastic Sheeting: Provide polyethylene sheets; use weights to retain sheeting in position.
  - 3. OSB Sheathing: Oriented strand board (OSB) wood structural panel; PS 2.
    - a. Grade: Sheathing.
    - b. Bond Classification: Exposure 1 OSB.
    - c. Edges: Square.
  - 4. Plywood Sheathing: PS 1, Grade C-D, Exposure I.

5. Provide thickness sufficient to prevent tearing or damage during use.
- C. Fiber Insulation Board: ASTM C208, Type II, Grade 1 cellulosic fiber insulating board, with natural surface finish.
  1. Compressive Strength: 14.5 lbf/sq inch, minimum.
  2. Board Size: 24 inch by 48 inch.
  3. Board Thickness: 1/2 inch.
  4. Thermal Conductivity, K-value: 0.38.
  5. Board Edges: Square.
- D. Glass Mat Gypsum Substrate: ASTM C1177/C1177M, Type X (special fire-resistant) and moisture resistant.
  1. Board Size: 4 feet by 8 feet.
  2. Board Thickness: 1/2 inch.
  3. Board Edges: Square.
- E. Fiber Insulation Board: ASTM C208, Type II, Grade 2 cellulosic fiber insulating board, 1-1/2 inch thick.
  1. Board Size: 4 feet by 8 feet.
  2. Board Edges: Square.

## **2.04 ACCESSORIES**

- A. Fasteners: Type and size as required and compatible with existing and new roofing system to resist local wind uplift.
- B. Sheathing Paper: Red rosin paper type, at least 3 lbs per 100 sq ft.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing site conditions.
- B. Verify that existing roof surface has been cleared of materials being removed from existing roofing system and ready for next phase of work as required.
- C. Document existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by re-roofing operations.
  1. Submit before work begins.
  2. Use high-resolution digital photographs or video tape supplemented by written commentary for preparing reports.

### **3.02 PREPARATION**

- A. Sweep roof surface clean of loose matter.
- B. Remove loose refuse and dispose of properly off-site.
  1. Free Fall Maximum: 8 feet, provide enclosed chutes for higher fall.

2. Do not use District's disposal system.

### **3.03 MATERIAL REMOVAL**

- A. Remove only existing roofing materials that can be replaced with new materials as the weather will permit.
- B. Remove metal counter flashings.
- C. Remove damaged portions of roofing membrane, perimeter base flashings, flashings around roof protrusions, pitch pans and pockets.
- D. Cut and lay flat any membrane blisters.
- E. Remove damaged insulation and fasteners, cant strips, blocking.
- F. Remove vapor retarder.
- G. Repair existing wood deck surface to provide smooth working surface for new roof system.

### **3.04 TEMPORARY PROTECTION**

- A. Provide temporary protective sheeting over uncovered deck surfaces.
- B. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.
- C. Provide for surface drainage from sheeting to existing drainage facilities.
- D. Do not permit traffic over unprotected or repaired deck surface.

### **3.05 FIELD QUALITY CONTROL**

- A. Independent agency inspection and testing will be provided under provisions of Section 01 40 00.
- B. Inspection firm will identify the exact limits to material removal.
- C. Testing will identify the condition of existing materials and their reuse, repair or removal.
- D. Test Reports: Indicate existing insulation moisture content and existing bitumen quality.

### **3.07 PROTECTION**

- A. Provide temporary protective sheeting over uncovered deck surfaces.
- B. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.
- C. Provide for surface drainage from sheeting to existing drainage facilities.
- D. Do not permit traffic over unprotected or repaired deck surface.

### **3.07 SCHEDULES**

- A. Entire Roofing Area: Remove existing roofing gravel, perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, insulation, and vapor retarder.
- B. Remove roof mounted mechanical equipment and electrical equipment.

**END OF SECTION**



**SECTION 07 01 50.20**  
**ROOFING, RESTORATION, PATCH, AND REPAIR**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Partial removal of existing roofing system in preparation for new penetrations.
- B. Patching and repair shall not void or reduce Contractor's and manufacturer's warranty of existing roofing. Removal of existing roofing and repair is to be done by the Roofing Contractor (if available) in which the roofing system was originally installed.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 01 50.19 - Preparation for Re-Roofing.
- B. Division 7 Roofing Section: Existing roofing system type and components to be restored.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings, reglets,.
- D. Division 23 - Heating, Ventilation and Air-Conditioning (HVAC): Roof mounted equipment, curbs, and ducts penetrating roofing membrane.
- E. Division 26 - Electrical.
  - 1. Conduit penetrating roofing membrane.

**1.03 REFERENCE STANDARDS**

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2017).
- B. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with affected mechanical and electrical work associated with roof penetrations.
- B. Preinstallation Meeting: Convene two weeks before starting work of this section.
  - 1. Attendance is mandatory at conference required in section specifying new roofing installation.
    - a. Require attendance by Contractor's superintendent and other supervisory and quality control personnel having responsibility for roofing, supervisory personnel of roofing installer and, if required for warranty provisions, representative of roofing products manufacturer.
    - b. Construction Manager, testing and inspection agency (if engaged by District), District's insurance underwriter (if necessary, at District's option), and Architect (if authorized by District) will attend.
    - c. At Contractor's option, installers of each component of related Work, including deck or substrate construction, rooftop equipment, penetrations of roof deck, and other Work integral with or adjacent to roofing may attend.



- d. If required, attendance shall include Authority Having Jurisdiction (AHJ). Contractor shall verify requirement with Authority Having Jurisdiction (AHJ) and arrange for attendance.
- 2. Establish at pre-bid job walk, number of layers to be removed and reconfirm at pre-installation conference.
- 3. See new roofing installation section for additional information.
- 4. Agenda items specific to patch and repair.
  - a. Review Drawings and Specifications for suitability for application of roofing system. Review application procedures and coordination required with related Work.
    - 1) Discuss changes and deviations from Drawings and Specifications, if any, recommended or required.
  - b. 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 requires coordination with roofing system.
  - c. Review Contract Document requirements and submittals for roofing system, including roofing schedule, inspection and testing, and environmental conditions.
    - 1) Identify which governing regulations or insurance requirements will affect roofing system installation.
  - d. Discuss anticipated weather, as well as procedures for responding to unacceptable weather, including using temporary roofing.
    - 1) 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.
  - e. Document discussions in writing, including actions required, and distribute copy of report to each meeting participant.
  - f. 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 Bidding and Contract Requirements.
- C. Schedule work to coincide with commencement of installation of new roofing system.

### **1.05 QUALITY ASSURANCE**

- A. Materials Removal Firm Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience.
- B. Industry Standards:
  - 1. Work specified in this Section shall comply to manufacturer's product data and application instructions.
  - 2. Work shall also conform to recommended practices and details published in NRCA Roofing and Waterproofing Manual, 1 and recommended practices and details of Western States Roofing Contractors Association (WSRCA), where such practices and details are more stringent.
- C. Testing and Inspection:

1. At District's option, services of an independent inspection and testing agency may be obtained. Costs of this service will be paid for by District.
2. Contractor shall cooperate with independent testing and inspection agency.

#### **1.06 SCHEDULING**

- A. Schedule work to coincide with commencement of installation of new roofing system.
- B. Remove only existing roofing materials that can be replaced with new materials as the weather will permit.

#### **1.07 FIELD CONDITIONS**

- A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.
- B. Maintain continuous temporary protection prior to and during installation of new roofing system.

#### **1.08 WARRANTY**

- A. Coordinate work to maintain roofing system warranty.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces affected by reroofing, by methods and with materials acceptable to warrantor.
  1. Notify warrantor of existing roofing system before proceeding, and upon completion of reroofing.
  2. Obtain documentation verifying that existing roofing system has been inspected by warrantor and warranty remains in effect. Submit documentation at Project closeout.

### **PART 2 PRODUCTS**

#### **2.01 SYSTEM DESCRIPTION**

- A. Indicated Roof Areas: Patch and repair existing roofing, perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, and insulation where required for the installation of new roof mounted equipment.
- B. Patch and repair roofing as necessary to provide complete, weathertight installation conforming to referenced industry standards and as necessary to accommodate new Work.
- C. Contract Drawings and Specifications:
  1. Contract Drawings and Specifications are diagrammatic and of a general nature only.
  2. Materials manufacturer's specifications for roofing and related flashings shall govern Work as if set forth herein, except as specifically indicated or where more stringent requirements are specified or required by Authority Having Jurisdiction (AHJ).
  3. All Work shall be completed as required to obtain specified warranty and guarantee.
- D. Design Review:
  1. Contractor, roofing installer and manufacturer's representative of the original roofing installation (if known or or identifiable) shall review Drawings and Specifications.

2. Obtain confirmation from roofing installer and manufacturer of original roofing (if known or identifiable) that selected roofing materials for patching and repair are proper, compatible and adequate for the Project and that conditions and details indicated and specified do not conflict with requirements and recommendations of manufacturer.
3. Maintain Class B roofing minimum

## **2.02 MATERIALS**

- A. Temporary Protection: Sheet polyethylene; provide weights to retain sheeting in position.
  1. Provide thickness sufficient to prevent tearing or damage during use.
- B. Protection Board: 1 cellulose fiber board, one face finished with mineral fiber, asphalt and kraft paper.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing site conditions.
- B. Verify that existing roof surface is clear and ready for work of this section.
  1. Verify that roof deck is structurally sound to support live and dead load requirements of roofing system and sufficiently rigid to support construction traffic.

### **3.02 PREPARATION**

- A. Coordination: Coordinate patching and repairs of roofing with installation of penetrations, supports and other adjoining new construction which affects existing roofing.
- B. Deck Preparation:
  1. Clean and prepare roof deck in accordance with roofing system manufacturer's instructions and recommendations.
  2. Correct substrate surfaces which are unacceptable to installer.
- C. Sweep roof surface clean of loose matter.
- D. Remove loose refuse and dispose off site.
  1. Free Fall Maximum: 8 feet, provide enclosed chutes for higher fall.
  2. Do not use District's disposal system.
- E. Deck Condition: Firm, smooth, clean and sufficiently dry to suit roofing manufacturer's requirements.
  1. Conduct moisture test of deck and surrounding roofing.
  2. Do not proceed with roofing application until deck and surrounding materials are dry.

### **3.03 MATERIAL REMOVAL**

- A. Remove only existing roofing materials that can be replaced with new materials as the weather will permit.
- B. Remove metal counter flashings.
- C. Remove damaged portions of roofing membrane, perimeter base flashings, flashings around roof protrusions, pitch pans and pockets.

- D. Cut and lay flat any membrane blisters.
- E. Remove damaged insulation and fasteners, cant strips, blocking .
- F. Remove sheathing paper and underlay..
- G. Repair existing underlying deck surface to provide smooth working surface for new roof system.

### **3.04 TEMPORARY PROTECTION**

- A. Provide temporary protective sheeting over uncovered deck surfaces.
- B. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.
- C. Provide for surface drainage from sheeting to existing drainage facilities.
- D. Do not permit traffic over unprotected or repaired deck surface.

### **3.05 PATCHING AND REPAIRS**

- A. General:
  - 1. It is intended to leave existing roofing intact as much as feasible.
    - a. Roofing Work is intended to be patching and repair of portions of existing roofing due to new:
      - 1) Structural supports.
      - 2) Penetrations.
      - 3) Heating, ventilating and air conditioning (HVAC) equipment.
      - 4) Electrical system penetrations.
    - b. Include repairs of areas damaged as result of construction activities.
  - 2. Comply with instructions and recommendations of manufacturer of existing roofing system for making patches and repairs.
  - 3. Comply also with recommended practices of referenced industry standards.
  - 4. Protect other Work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace and restore other construction damaged or degraded by roofing Work.
  - 5. Apply roofing materials in accordance with NRCA Roofing and Waterproofing Manual and published details and recommendations of Western States Roofing Contractors Association (WSRCA).
  - 6. Keep roofing materials dry before and during application. Do not permit phased construction.
- B. Flashing Replacement: Entire sheet of flashing membrane is to be adhered to vertical substrate and hot-air welded to the secured field membrane.
- C. Penetrations:
  - 1. Coordinate roofing Work with plumbing, mechanical and electrical Work and other Work involving penetrations of roofing membrane.
  - 2. Provide pipe and conduit penetrations as indicated on Drawings, or if more stringent, as detailed in NRCA - Roofing and Waterproofing Manual.

- 3. Verify that penetrations through roof are adequately separated by a minimum of 18 inches from each other, away from curbs, platforms, sleepers and walls and are also located a minimum of 24 inches beyond all waterways.
- D. Other Roofing Accessories: Install other accessories in accordance with manufacturer's instructions and recommendations, and NRCA Construction Details, as applicable.
- E. Crickets and Tapered Areas: Install to provide positive slope at proper transitions at changes in roof plane.
- F. Flashing and Sheet Metal Work: Set and flash in integrated sheet metal.

### **3.06 FIELD QUALITY CONTROL**

- A. Independent agency inspection and testing will be provided under provisions of Section 01 40 00.
- B. The drawings identify the approximate limits to material removal.
- C. Testing will identify the condition of existing materials and their reuse, repair or removal.
- D. Test Reports: Indicate existing insulation moisture content and existing roof system quality.

### **3.07 PROTECTION**

- A. Provide temporary protective sheeting over uncovered deck surfaces.
- B. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.
- C. Provide for surface drainage from sheeting to existing drainage facilities.
- D. Do not permit traffic over unprotected or repaired deck surface.

### **3.08 SCHEDULES**

- A. Roof Areas as Indicated: Remove, where required, existing perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, and insulation.
- B. Remove indicated roof mounted mechanical equipment and electrical equipment.

**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.

**1.03 REFERENCE STANDARDS**

- A. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- B. ASTM D1709 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings; 2008 (Including Addendum C222A-09).
- C. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
- 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.
- 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. permittance), Class A, unreinforced polyolefin: [www.fortifiber.com](http://www.fortifiber.com).
  - 2. Raven Industries; VaporBlock VB15, 15 mils thick (0.01 perms), Class A, unreinforced polyolefin: [ravenefd.com](http://ravenefd.com),
  - 3. Reef Industries, Inc.; Vaporguard, 15 mil (E-96 0.000 perms), Class B: [www.reefindustries.com](http://www.reefindustries.com)
  - 4. Stego Industries LLC; Stego Wrap Vapor Barrier, 15 mils: [www.stegoindustries.com](http://www.stegoindustries.com).
  - 5. W.R. Meadows; Perminator, 15 mils thick (0.0063 perms, puncture resistant) Class A: [www.wrmeadows.com](http://www.wrmeadows.com)..
  - 6. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 PERFORMANCE REQUIREMENTS**

- A. Water Vapor Permeance: Not more than 0.010 perms, maximum.
  - 1. Permeance as tested after conditioning (1).
- B. Comply with 1 Class A.
- C. Puncture Resistance, ASTM D1709: 2,300 gms.

### **2.03 MATERIALS**

- A. Reinforced Vapor Barrier:
  - 1. Minimum Thickness 1: 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 1. 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 1.
  - 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 1.
  - 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 UNDER SLAB 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 62 00**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings and counterflashings.
- B. Sealants for joints within sheet metal fabrications.

**1.02 RELATED REQUIREMENTS**

- A. Division 7 - Thermal and Moisture Protection: Roofing system.
- B. Section 07 62 70 - Exterior Penetration Flashing Panels: Prefabricated flashing sleeves and collars for electrical, mechanical and plumbing items protruding through exterior walls.
- C. Section 07 72 00 - Roof Accessories: Manufactured metal roof curbs.
- D. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
- H. Section 09 91 13 - Exterior Painting: Field painting.

**1.03 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.
  - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2018.
- E. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015e1.
- F. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.
- G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007, with Editorial Revision (2012).
- H. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
- I. ASTM D792 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2013.
- J. 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.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 6 x 6 inch in size illustrating metal finish color.

### **1.06 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. 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. 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, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
  - 2. Color: As selected by Architect from manufacturer's custom colors.

### **2.02 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
  - 1. Coping and Cap Flashing:
    - a. Coping and caps of type and profile indicated on Drawings, 20 gage galvanized sheet metal, with integral expansion.
  - 2. Drips at Doors and Windows:
    - a. Provide 20 gage galvanized sheet metal drips at head of all exterior doors and windows where no roof or overhang protection occurs.
    - b. Extend drips 2 inches beyond jambs, unless noted otherwise.
- B. 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.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. 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 EXTERIOR PENETRATION FLASHING PANELS**

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
- B. Basis of Design Product: Quickflash Weatherproofing Flashing Panels as manufactured by Quickflash Weatherproofing Products, Inc., [www.quickflashproducts.com](http://www.quickflashproducts.com), or approved equal.
- C. Coordinate with each trade to provide specific models correctly sized for each individual pipe, duct, conduit, box, or panel penetration in each application as occurs in the building envelope.

D. Plumbing Flashing Panels:

1. Materials:

- a. Panel: Combination of high-density polyethylene (HDPE) and low-density polyethylene (LDPE).
  - 1) HDPE, Specific Gravity, ASTM D3763: 0.953 g/cm<sup>3</sup>.
  - 2) HDPE, Tensile Strength at Yield, ASTM D638: 3,100 psi.
  - 3) LDPE, Specific Gravity, ASTM D792: 0.917 g/cm<sup>3</sup>.
  - 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/cm<sup>3</sup>.
  - 3) Tensile Strength, ASTM D412: 490 psi.

E. Electrical Flashing Panels:

1. Material: Thermoplastic elastomer.

- a. Hardness, ASTM D2240, Shore A, 10 Seconds: 93.
- b. Specific Gravity, ASTM D792: 1.05 g/cm<sup>3</sup>.
- c. Tensile Strength, ASTM D412: 1,300 psi.

## 2.05 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Miscellaneous Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of the Work, matching or compatible with material being installed, non-corrosive, size and gage required for performance.
- C. Underlayment: Self-adhesive sheet flexible flashing complying with ASTM D1970/D1970M.
  - 1. Adhesives: Type recommended by flexible flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
- D. Slip Sheet: Rosin sized building paper.
- E. Primer: Zinc chromate type.
- F. Concealed Sealants: Non-curing butyl sealant.
- G. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
  - 1. Epoxy Seam Sealer: 2-part non-corrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior non-moving joints including riveted joints.
- H. Plastic Cement: ASTM D4586/D4586M, Type I.

## 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 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.

### **3.04 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.

**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 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- B. Division 23 - Heating, Ventilation, & Air-Conditioning: HVAC piping or small sheet metal ducts.
- C. Division 26 – Electrical

**1.03 REFERENCES**

- A. ASTM D3763 - Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding; 2006.
- B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015e1.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016.
- 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.
- 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](http://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/cm<sup>3</sup>.
      - 2) HDPE, Tensile Strength at Yield, 1: 3,100 psi.
      - 3) LDPE, Specific Gravity, 1: 0.917 g/cm<sup>3</sup>.
      - 4) LDPE, Tensile Strength at Yield, 1: 1,300 psi.
    - b. Weatherproof Seal: Thermoplastic elastomer.
      - 1) Hardness, 1, Shore A, 10 Seconds: 46.
      - 2) Specific Gravity, 1: 1.05 g/cm<sup>3</sup>.
      - 3) Tensile Strength, 1: 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, 1, Shore A, 10 Seconds: 93.
    - b. Specific Gravity, 1: 1.05 g/cm<sup>3</sup>.
    - c. Tensile Strength, 1: 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, manual and automatic operation, including smoke vents.
- E. Roof walkways and platforms.
- F. Non-penetrating pedestals.

**1.02 RELATED REQUIREMENTS**

- A. Section 05 50 00 - Metal Fabrications.
- B. 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 - Ladders; current edition.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.
- 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; 2018.
- H. OSHA 29 CFR 1910.23 - Fall Protection in General Industry; current edition.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – 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 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for 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](http://www.aescurb.com).
  2. Custom Curb, Inc.; Model No. CRC-3.
  3. Portals Plus: [www.portalsplus.com](http://www.portalsplus.com).

4. Thybar Corp.; Model No. TC-3; [www.thybar.com](http://www.thybar.com)
  5. The Pate Company; Model No. pc-2: [www.patecurbs.com](http://www.patecurbs.com).
  6. Roof Products & Systems (RPS): [www.rpscurbs.com](http://www.rpscurbs.com).
  7. Substitutions: See Section 01 60 00 - Product Requirements.
- 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. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
  2. Sheet Metal Material:
  3. 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.
  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 VENTS, MANUAL AND AUTOMATIC OPERATION**

- A. Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
  - 1. Style: Provide flat metal covers unless otherwise indicated.
  - 2. Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.
  - 3. Size: As indicated on drawings; single-leaf style unless indicated as double-leaf.
    - a. For Ladder Access: Single leaf; 36 by 36 inches.
- B. 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.
- C. 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.

## **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](http://www.s-5.com/#sle).
  - b. PHP Systems/Design: [www.phpsd.com](http://www.phpsd.com).
  - c. Portals Plus: [www.portalsplus.com/#sle](http://www.portalsplus.com/#sle).
  - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
  1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
  2. See relevant piping system specification section for additional requirements.
- C. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
  1. Bases: High density polypropylene.
  2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
  4. Manufacturers:
    - a. Metal Roof Innovations, Ltd. S-5! Attachment Solutions; S-5! Utility System: [www.s-5.com/#sle](http://www.s-5.com/#sle).
    - b. Portals Plus; Pedestal Plus: [www.portalsplus.com/#sle](http://www.portalsplus.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.

## **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 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 70 00 - Execution and Closeout Requirements: Cutting and patching.
- 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; 2018c.
  - 1. Use 2012a as indicated in 2016 CBC Referenced Standards.
- D. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
  - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- E. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015.
  - 1. Use 2007a as indicated in 2016 CBC Referenced Standards.
- F. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2018.
  - 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, with Editorial Revision (2016).
  - 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](http://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 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- 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 Edition.
- T. UL (FRD) - Fire Resistance Directory; Current Edition.
  - 1. UL runs 1 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 - Administrative Requirements, 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](http://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](http://www.stifirestop.com/#sle).
  2. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
  3. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
  4. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  5. Nelson FireStop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com).
  6. Rectorseal; Bio FireShield and Metacaulk Systems: [www.rectorseal.com](http://www.rectorseal.com).
  7. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  8. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 REGULATORY REQUIREMENTS**

- A. Firestop System installation must meet requirements of 1, 3, 2 and UL 1479 or 1 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 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 07 26 16 - Under-Slab Vapor Retarders.
- C. Section 07 84 00 - Firestopping: Firestopping sealants.
- D. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- E. 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; 2018.
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012 (Reapproved 2017).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.
- K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015e1.
- L. SWRI (VAL) - SWR Institute Validated Products Directory; Current Edition.

#### 1.04 SUBMITTALS

- A. See Section 01 33 00 – 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 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.



- C. Warranty: Include coverage for 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](http://www.atcepoxy.com).
  - 2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 3. Dow Corning Corporation: [www.dowcorning.com/construction/sle](http://www.dowcorning.com/construction/sle).
  - 4. Fortifiber Building Systems Group: [www.fortifiber.com/sle](http://www.fortifiber.com/sle).
  - 5. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  - 6. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  - 7. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com/sle](http://www.momentive.com/sle).
  - 8. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 9. The QUIKRETE Companies: [www.quikrete.com](http://www.quikrete.com).
  - 10. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 11. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  - 12. Specified Technologies Inc: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
  - 13. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - 14. W.R. Meadows, Inc: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
  - 15. Substitutions: See Section 01 60 00 - Product Requirements.
- 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](http://www.atcepoxy.com).
  - 2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 3. Dayton Superior Corporation: [www.daytonsuperior.com](http://www.daytonsuperior.com).
  - 4. Dow Corning Corporation: [www.dowcorning.com/construction/sle](http://www.dowcorning.com/construction/sle).
  - 5. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  - 6. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 7. The QUIKRETE Companies: [www.quikrete.com](http://www.quikrete.com).
  - 8. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 9. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  - 10. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - 11. W.R. Meadows, Inc: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
  - 12. Substitutions: See Section 01 60 00 - Product Requirements.

## 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 as indicated in Section 01 61 16.
- B. Colors: As indicated on the drawings. Match adjacent surface.

### **2.04 NONSAG JOINT SEALANTS**

- A. Type NS-1 - Non-Staining Silicone Sealant: 1, 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: \_\_\_\_\_.
  5. Service Temperature Range: Minus 20 to 180 degrees F.
  6. Manufacturers:
    - a. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - b. Dow Chemical Company; DOWSIL 791 Silicone Weatherproofing Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - c. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - d. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com/sle](http://www.momentive.com/sle).
    - e. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - f. Sika Corporation; Sikasil WS-290: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - g. Sika Corporation; Sikasil WS-295: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - h. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Silicone Sealant: 1, 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](http://www.fortifiber.com/#sle).
    - b. Dow Chemical Company; DOWSIL 999-A Building and Glazing Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - c. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com/sle](http://www.momentive.com/sle).
    - d. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - e. Sherwin-Williams Company; Silicone Rubber All Purpose Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - f. Sika Corporation; Sikasil GP: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Type FS-1 - Mildew-Resistant Silicone Sealant: 1, 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](http://www.buildingsystems.basf.com).
    - b. Dow Corning Corporation; 786 Silicone Sealant: [www.dowcorning.com](http://www.dowcorning.com).
    - c. Momentive Performance Materials, Inc (GE Silicones products); Silpruf SCS 1700 Sanitary: [www.momentive.com](http://www.momentive.com).
    - d. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - e. Sika Corporation; Sikasil GP: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - f. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Type ST-1 - Silyl-Terminated Polyether (STPE) and Polyurethane (STPU) Sealant: 1, 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](http://www.sherwin-williams.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.

- E. Tamper-Resistant, Silyl-Terminated Polyurethane (STPU) Sealant: 1, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
  - 1. Movement Capability: Plus and minus \_\_\_ 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](http://www.pecora.com).
    - b. Sika Corporation; SikaHyflex-150 LM: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
  
- F. Type PS-1 - Polyurethane Sealant: 1, 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 \_\_\_\_ 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](http://www.quikrete.com/#sle).
    - b. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - c. Sika Corporation; Sikaflex-1a: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - d. Sika Corporation; Sikaflex-15 LM: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - e. W. R. Meadows, Inc; POURTHANE NS: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - f. Substitutions: See Section 01 60 00 - Product Requirements.
  
- G. Type WP-1 - Polyurethane Sealant for Continuous Water Immersion: 1, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface .
  - 1. Movement Capability: Plus and minus 35 percent, minimum.
  - 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
  - 3. Color: To be selected by Architect from manufacturer's full range.
  - 4. Service Temperature Range: Minus 40 to 180 degrees F.
  - 5. Manufacturers:
    - a. Sika Corporation; Sikaflex-1a: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
  
- H. Non-Sag "Traffic-Grade" Polyurethane Sealant: 1, 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.
- I. Tamper-Resistant Polyurethane Sealant: 1, 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.
- J. Epoxy Sealant: 1, 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 D, when tested in accordance with ASTM C661.
  2. Color: To be selected by Architect from manufacturer's full range.
  3. Service Temperature Range: 40 to 120 degrees F.
  4. Manufacturers:
    - a. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
- K. Polysulfide Sealant: 1, 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](http://www.pecora.com).
    - b. W.R. Meadows, Inc; Deck-O-Seal Gun Grade: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
- L. Polysulfide Sealant for Continuous Water Immersion: Polysulfide; 1, 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](http://www.pecora.com/#sle).
    - b. W.R. Meadows, Inc; Deck-O-Seal Gun Grade: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.

- M. Acrylic-Urethane Sealant: Water-based; 1, 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: 15 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](http://www.sherwin-williams.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
- N. Type IA-1 - Acrylic Emulsion Latex: Water-based; 1, 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 (0 Degrees F).
  - 3. Manufacturers:
    - a. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - b. Hilti, Inc; CP 572 Smoke and Acoustical Spray Sealant: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - c. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - d. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - e. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
    - f. Substitutions: See Section 01 60 00 - Product Requirements.
- O. Non-Curing Butyl Sealant: Solvent-based; 1; 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: 1, 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](http://www.usa-sika.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Type P-1 - Self-Leveling Polyurethane Sealant: 1, 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](http://www.pecora.com).
    - b. The QUIKRETE Companies; QUIKRETE® Polyurethane Self-Leveling Sealant: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
    - c. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - d. Sika Corporation; Sikaflex-1c SL: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Type WFP-1 - Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; 1, 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](http://www.usa-sika.com/#sle).
    - b. W. R. MEADOWS, Inc; POURTHANE SL: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Self-Leveling Silyl-Terminated Polyether/Polyurethane (STPE/STPU) Sealant: 1, 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](http://www.pecora.com).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Self-Leveling Polysulfide Sealant: 1, 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](http://www.wrmeadows.com/#sle).
  - b. Substitutions: See Section 01 60 00 - Product Requirements.
  
- 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](http://www.ardexamericas.com/#sle).
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
  
- 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; \_\_\_\_\_: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - b. Euclid Chemical Company; EUCO 700: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).
    - c. Nox-Crete; DynaFlex 502: [www.nox-crete.com/#sle](http://www.nox-crete.com/#sle).
    - d. W.R. Meadows, Inc; Rezi-Weld Flex: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
  
- 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](http://www.atcepoxy.com/#sle).
    - b. ARDEX Engineered Cements; ARDEX ARDISEAL RAPID PLUS: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - c. Euclid Chemical Company; EUCO QWIKjoint UVR: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).

- d. Nox-Crete; DynaFlex JF-85: [www.nox-crete.com/#sle](http://www.nox-crete.com/#sle).
- e. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.06 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: 1; Type C - Closed Cell Polyethylene.
  - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
  - 3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## **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. Verify that backer rods are of the correct size.
- D. 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 09 21 16**  
**GYPSUM 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. Acoustic insulation.
- E. Gypsum sheathing.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

**1.03 REFERENCE STANDARDS**

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2012.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- E. 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.
- F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
  - 1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
  - 1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2018b.

1. Use 2011 as indicated in 2016 CBC Referenced Standards.
- J. 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.
- K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
  1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- M. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2018a.
  1. Use 2006(Reapproved 2011) as indicated in 2016 CBC Referenced Standards.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
  1. Use 2013a as indicated in 2016 CBC Referenced Standards.
- P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
  1. Use 2009 as indicated in 2016 CBC Referenced Standards.
- Q. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- R. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
  1. Use 2013 as indicated in 2016 CBC Referenced Standards.
- S. GA-600 - Fire Resistance Design Manual; 2015.
  1. Use 2009 as indicated in 2016 CBC Referenced Standards.

#### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – 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. 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. Manufacturers - Metal Framing, Connectors, and Accessories:
  - 1. Cemco: [www.cemcosteel.com](http://www.cemcosteel.com).



- a. ICC ESR-2012.
- b. Viper-x Studs: IAPMO ER-0524, ICC ESR-2620.
2. ClarkDietrich Building Systems: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  - a. ICC ESR-1166P
3. Marino: [www.marinoware.com/#sle](http://www.marinoware.com/#sle).
  - a. Viper-x Stud: IAPMO ER-0524, ICC ESR-2620.
  - b. ICC ESR-4062.
4. Phillips Manufacturing Co: [www.phillipsmfg.com/#sle](http://www.phillipsmfg.com/#sle).
5. SCAFCO Corporation: [www.scafco.com/#sle](http://www.scafco.com/#sle).
6. Steel Stud Manufacturers Association [www.ssma.com](http://www.ssma.com).
  - a. ICC ESR-3064P
7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
  1. Studs: "C" shaped with flat or formed webs with knurled faces.
  2. Runners: U shaped, sized to match studs.
  3. Headers: As detailed on Drawings or ProX Header per IAPMO ER-2086.
- C. 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](http://www.metal-lite.net) or approved equivalent.
  3. As indicated on Drawings.
- D. 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. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
    - a. Products:
      - 1) FireTrak Corporation; Posi Klip.
      - 2) Metal-Lite, Inc; The System.
      - 3) Substitutions: See Section 01 60 00 - Product Requirements.

- E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
  - 1. Products:
    - a. BlazeFrame: "BlazeFrame"; [www.blazeframe.com](http://www.blazeframe.com).
    - b. Brady Sliptrack Systems: FAS Track; [www.sliptrack.com](http://www.sliptrack.com), ICC-ES ESR-2012.
    - c. CEMCO: FAS Track; [www.cemcosteel.com](http://www.cemcosteel.com), ICC-ES ESR-2012.
    - d. ClarkDietrich; BlazeFrame Firestop Deflection Track: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
    - e. Rectorseal, Inc.; Track-Safe: [www.biofireshield.com](http://www.biofireshield.com).
    - f. Ware Industries, Inc. (dba Marinoware): CST; [www.marinoware.com](http://www.marinoware.com), ICC-ES ESR-2012.
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- F. 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. CEMCO: HOT ROD Type X; [www.cemcosteel.com](http://www.cemcosteel.com), ICC-ES ESR-2012.
    - b. Hilti, Inc; Top Track Seal CFS TTS: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - c. Specified Technologies Inc; SpeedFlex TTG Track Top Gasket: [www.stfirestop.com/#sle](http://www.stfirestop.com/#sle).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Non-Loadbearing Framing Accessories:
  - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
    - a. Provide a premanufactured wall brace compliant with CBC Section 1607A.7.1 .
    - b. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
    - c. Height: 35-3/4 inches.
    - d. Products:
      - 1) ClarkDietrich; Pony Wall (PW): [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
      - 2) The Steel Network, Inc.; MidWall; [www.steelnetwork.com](http://www.steelnetwork.com).
      - 3) USG, Inc.; [www.usg.com](http://www.usg.com).
      - 4) Substitutions: See Section 01 60 00 - Product Requirements.
    - e. Alternate Method Partial-Height Wall Brace: Provide steel post as indicated on Drawings.
  - 3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

### 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](http://www.certainteed.com/#sle).
  2. Georgia-Pacific Gypsum: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
  3. National Gypsum Company: [www.nationalgypsum.com/#sle](http://www.nationalgypsum.com/#sle).
  4. PABCO Gypsum: [www.pabcogypsum.com/#sle](http://www.pabcogypsum.com/#sle).
  5. USG Corporation: [www.usg.com/#sle](http://www.usg.com/#sle).
  6. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
    - b. Mold resistant board is required 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; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall.
    - b. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
    - c. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
    - d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
    - e. National Gypsum Company; Gold Bond XP Gypsum Board.
    - f. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- D. 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 60 00 - Product Requirements.

#### **2.04 Gypsum Wallboard Accessories**

- A. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, 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 60 00 - Product Requirements.
  - 2. Corner Beads: Low profile, for 90 degree outside corners.
    - a. Cornerbead: USG Sheetrock B1 XW EL, or equal.
    - b. L Trim: USG Paper-faced "L" trim, B4 or equal.
- B. 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.
  - 3. Joint Compound: Setting type, field-mixed.
- C. 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.
- D. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- E. Adhesives
  - 1. Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.
    - a. Adhesive shall contain a maximum VOC content of 50 grams per liter.
    - b. Adhesive must meet the requirements of low emitting materials credit.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

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

- B. 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 construction attaches to or abuts, including the following.
  - 1. Preset hollow metal frames
  - 2. Piping.
  - 3. Conduit.
  - 4. 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 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 in all locations.
  - 2. 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 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.

### **3.03 BOARD INSTALLATION**

- A. Regulatory Requirements: Install gypsum board products in accordance with applicable Code requirements and requirements of listed assemblies shown on Drawings.
- B. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- C. Single-Layer 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 721.1(2) 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 721.1(2). 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. 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.
- H. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
1. Single-Layer Applications: Screw attachment.
  2. Double-Layer Application: Install base layer using screws or nails. Install face layer using adhesive.

### **3.04 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Use longest practical lengths. Place corner beads at external corners. Place edge trim when gypsum board abuts dissimilar materials. Surfaces indicated to receive non-textured finish and semi-gloss enamels.
- B. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
1. Not more than 30 feet apart on walls and ceilings 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.

### **3.06 JOINT TREATMENT**

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 5: Walls and ceilings to receive, eggshell, semi-gloss or gloss paint finish and other areas specifically indicated. (Including High-Gloss thin wallcovering.)
  2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  3. Level 3: Walls to receive textured wall finish or heavy textured paint.
  4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

6. Level 0: Temporary partitions.
- D. Tape, fill, and sand all exposed joints, edges, and corners, including inside corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  2. Tape shall be set over joint and seated into joint compound, leaving sufficient adhesive under tape to provide proper bond.
  3. Internal angles, both horizontal and vertical, shall be reinforced and with tape folded to form straight and true angle.
  4. Metal external corners shall be cemented in place.
  5. Joints shall be allowed to dry according to Gypsum Association Standards based on temperature and humidity. Allow for at least 24 hours between each application of joint compound.
  6. The final application of compound and sanding shall leave all surfaces uniformly smooth and in condition to receive specified finish.
  7. Taping, filling, and sanding 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. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### **3.07 TOLERANCES**

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

### **3.08 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

### 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 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 2018).
  - 1. Use 2003(2013) as indicated in 2016 CBC Ch. 35 Referenced Standards.
- D. ASTM C847 - Standard Specification for Metal Lath; 2018.
  - 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; 2018.
  - 1. Use 2007 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- G. ASTM C1032 - Standard Specification for Woven Wire Plaster Base; 2018.
- H. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2019.
  - 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 – 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](http://www.brandxmetals.com).
  - 2. Cemco: [www.cemcosteel.com/#sle](http://www.cemcosteel.com/#sle).
  - 3. Clarkwestern Dietrich Building Systems LLC: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  - 4. Fry Reglet: [www.fryreglet.com](http://www.fryreglet.com).
  - 5. Pittcon Industries: [www.pittconindustries.com](http://www.pittconindustries.com).
  - 6. Structa Wire Corporation: [www.structawire.com/#sle](http://www.structawire.com/#sle).
  - 7. Substitutions: See Section 01 60 00 - Product Requirements.

### **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, comply with deflection criteria, 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](http://www.fryreglet.com).
  - b. Acceptable Manufacturers:
    - 1) Interior Specialties Division, Gordon, Inc.; [www.gordon-inc.com](http://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. 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.
- B. 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.
- C. Tie Wire: Annealed galvanized steel.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. For exterior plaster and stucco on stud walls, verify that water-resistive barrier has been installed over sheathing substrate completely and correctly.
  - 1. Do not allow the control or expansion joints to interrupt or be lapped with the weather barrier.
- D. Do not begin until unacceptable conditions have been corrected.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 INSTALLATION - GENERAL**

- A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.
- B. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.
- C. Install lath and furring for fire-rated assemblies in accordance with requirements of assembly as indicated.

### **3.03 CEILING AND SOFFIT FRAMING INSTALLATION**

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Install furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- H. Laterally brace suspension system.

### **3.04 CONTROL AND EXPANSION JOINT INSTALLATION**

- A. At unsheathed open framing, provide double stud construction behind control joint.
- B. Locate joints as indicated on drawings and comply with ASTM C1063.
  - 1. Area of plaster panel not to exceed 144 sq ft for vertical surfaces.
    - a. Expansion Joint Spacing: 36 feet 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 07 62 70 - Exterior Penetration Flashing Panels: Prefabricated flashing sleeves and collars for electrical, mechanical and plumbing items protruding through exterior walls.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum Sheathing: Solid backing at all exterior plaster.
- C. Section 09 22 36 - Lath: Lath, furring, beads, screeds, and joint accessories for plaster base.
- D. Section 09 91 13 - Exterior Painting: Finish paint over intergral color plaster.

**1.03 REFERENCE STANDARDS**

- A. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
- B. ASTM C206 - Standard Specification for Finishing Hydrated Lime; 2014.
- C. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- D. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2018a.
- 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; 2018c.
- G. CBC - Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment; Current Adopted Edition.
- H. TSIB (PAM) - Plaster Assemblies Manual, Technical Services Information Bureau; Current Edition.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal 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.

### **2.02 FACTORY PREPARED CEMENT PLASTER**

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
  - 1. CBC, Section 2504.2.1 Wood furring strips (DSA & OSHPD 1& 4), 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](http://www.parexusa.com/#sle).
3. Other Acceptable Manufacturers:
  - a. Omega Products International, Inc.; Super Cement with Crack Isolation System: [www.omega-products.com](http://www.omega-products.com).
  - b. Parex USA, Inc; Armourwall 300: [www.parexusa.com/#sle](http://www.parexusa.com/#sle).
  - c. Substitutions: See Section 01 60 00 - Product Requirements.
- 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.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 09 22 36.
- C. Bonding Compound: Provide type recommended for bonding plaster to solid surfaces, complying with ASTM C932.
- D. Reinforcing Mesh: 4.5 oz/sq yd alkali-resistant mesh.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.
- C. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

### **3.02 PREPARATION**

- A. Removal and Refinishing Existing Exterior Plaster Finish Coat: Sandblast existing exterior plaster walls to remove paint finish and finish coat plaster down to a level, workable surface.
  1. Sandblasted gouges due to over sandblasting, may require a leveling or skim brown coat mixture applied after wash down.
  2. Wash down to remove dust and other loose particles.
  3. Follow with finish coat over dampened surfaces.

- 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. OmegaFlex Fine
    - c. Parex 534 Sand Fine.
- E. Finish Painting Overcoat: See Section 09 91 13 - Exterior Painting.

### 3.05 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet.

### 3.06 REPAIR

- A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.
- B. Damaged Plaster:
  - 1. Plaster Detached from Framing:
    - a. Remove loose and broken plaster.

- b. Repair or replace damaged water-resistant backing and lath in compliance with specified standards.
  - c. Remove finish coat from surrounding area in the same plane by sandblasting.
  - d. Provide a scratch coat and a brown coat mixed with liquid bonding agent instead of water to the areas devoid of plaster.
  - e. Provide a coat of liquid bonding agent to entire wall plane.
  - f. Provide 1/8 inch thick finish coat to entire wall plane. Match existing texture and color.
2. Cracked Plaster 1/8 inch to 1/2 inch:
- a. Remove loose material from crack with a wire brush.
  - b. Fill crack with slurry of stucco and liquid bonding agent.
  - c. Provide a coat of liquid bonding agent to entire wall plane.
  - d. Provide 1/8 inch thick finish coat to entire wall plane and match existing texture and color.
3. Cracks Larger than 1/2 inch - Painted:
- a. Remove loose material from crack with a wire brush.
  - b. Fill crack with slurry of one part Portland cement to three parts masonry or stucco sand and liquid bonding agent to match existing texture of adjacent surface.
  - c. Paint entire wall plane, color to match existing.
  - d. Where patching of plaster over existing lath is feasible, fasten loose lath and install new lath with nails at 6 inch centers.
    - 1) Where metal is furnished, lap new lath 6 inches over existing and tie at 6 inch centers.
    - 2) Provide waterproof, air barrier, and vapor barrier as required, shingled into existing.
  - e. Patching of Holes, Cracks, and Gouges:
    - 1) Patch holes, cracks, gouges, missing sections, and other defects in existing improvements.
    - 2) For holes over 1 inch in size, cut small sections of lath and place in opening attached to existing material.
      - (a) Install 3 coats of plaster.
    - 3) For holes one inch and smaller, install bonding agent to existing surfaces and neatly fill hole with plaster, installing necessary coats to match adjacent surfaces, eliminate cracks and match existing surface texture.
    - 4) Cracks, gouges, and other defects shall be filled with plaster or spackle as required and neatly finished to match adjacent existing improvements.

**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. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
  - 1. Exposed surfaces of steel lintels and ledge angles.
  - 2. Mechanical and Electrical:
    - a. On the roof and outdoors, paint equipment that is exposed to weather or to view, including factory-finished materials.
- D. 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, 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.

**1.03 DEFINITIONS**

- A. Comply with ASTM D16 for interpretation of terms used in this section.

**1.04 REFERENCE STANDARDS**

- A. AHRI 340/360 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500 MM (12- to 60-in.) Diameter; 2013.
- 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 - Architectural Coatings; 1977 (Amended 2016).
- E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- F. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

### **1.05 SUBMITTALS**

- A. See Section 01 33 00 – 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.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- G. Maintenance Materials: Furnish the following for District's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
  - 3. Label each container with color in addition to the manufacturer's label.

### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years documented experience 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](http://www.behr.com/#sle).
    - a. Local representative Jan Piccola 714.679.5730.
  - 2. Dunn-Edwards Corporation: [www.dunnedwards.com](http://www.dunnedwards.com),
    - a. Local representative Wanda Barragan 909.261.1289.
  - 3. PPG Paints: [www.ppgpaints.com/#sle](http://www.ppgpaints.com/#sle).
  - 4. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - a. Local representative John Dumesnil 619.665.9341.
  - 5. Vista Paint: [www.vistapaint.com](http://www.vistapaint.com).
    - a. Local representative Mark Brower 323.397.9000.

- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.02 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
  - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
  - 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.
- C. Volatile Organic Compound (VOC) Content:
  - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. AHRI 340/360--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 AHRI 340/360 (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Flammability: Comply with applicable code for surface burning characteristics.
- E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- F. Colors: As indicated on drawings.
  - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

## **2.03 PAINT SYSTEMS - EXTERIOR**

- A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete masonry units and primed metal.
  - 1. One or two coats to cover and one coat primer.
  - 2. Top Coat(s): Exterior Latex.
  - 3. Top Coat Sheen:

- a. Flat: MPI gloss level 1; use this sheen at all locations.
  - b. Semi-Gloss: MPI gloss level 5; use this sheen at trim.
- 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Masonry/Concrete and CMU Opaque, Latex, 3 Coat:
  - 1. One coat of latex primer sealer.
  - 2. Low-Sheen-Elastomeric: Two coats of latex-acrylic.
  - 3. Premium Flat: Two coats of latex-acrylic enamel.
- C. Exterior Plaster, Opaque, 100% Acrylic Latex, 3 Coat:
  - 1. One coat of latex primer sealer.
  - 2. Flat: Two coats of latex.
- D. Ferrous Metals, Unprimed, Latex, 3 Coat:
  - 1. One coat of latex primer.
- E. Ferrous Metals, Primed, Latex, 2 Coat:
  - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
- F. Ferrous Metals, Unprimed, High-Performance, 3 Coat:
  - 1. Pre-Treatment: As recommended by manufacturer
  - 2. One coat galvanize primer.
  - 3. Gloss: Two coats of alkyd enamel; Behr Paint, 8200 Premium Direct-To-Metal Gloss Paint.

#### **2.04 PRIMERS**

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
  - 1. Alkali Resistant Water Based Primer.
  - 2. Interior/Exterior Latex Block Filler.
  - 3. Anti-Corrosive Alkyd Primer for Metal.
  - 4. Interior/Exterior Quick Dry Alkyd Primer for Metal.
  - 5. Alkyd Primer for Galvanized Metal.
  - 6. Water Based Primer for Galvanized Metal.
    - a. Products:
      - 1) Behr Premium Plus Interior/Exterior Multi-Surface Primer and Sealer [No. 436].
      - 2) Substitutions: Section 01 60 00 - Product Requirements.
  - 7. Rust-Inhibitive Water Based Primer.
  - 8. Interior/Exterior Quick Dry Primer for Aluminum.
  - 9. Stain Blocking Primer.

#### **2.05 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially 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.
  - 2. Masonry, Concrete, and Concrete Masonry Units: 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. Masonry:
  - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
  - 2. Prepare surface as recommended by top coat manufacturer.
  - 3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.
- H. 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.
- I. 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.
- J. 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.

### **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 40 00 - Quality Requirements, for general requirements for field inspection.

### **3.05 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### **3.06 PROTECTION**

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

**END OF SECTION**



**SECTION 23 00 00**  
**GENERAL MECHANICAL REQUIREMENTS**

**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 SCOPE**

- A. Basic mechanical requirements specifically applicable to Division 23 and 33 Sections.
- B. Work includes but is not necessarily limited to the following:
  - 1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
    - a. Heating, ventilating and air conditioning systems and equipment
    - b. Testing, adjusting and balancing

**1.03 DRAWINGS AND SPECIFICATIONS**

- A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a workmanlike manner.
- B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.
- C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Owner has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Owner's Representative.
- D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.
- E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

**1.04 UTILITIES**

- A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data



given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

### **1.05 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS**

- A. Meet requirements of all state codes having jurisdiction.
- B. State of California Code of Regulations:
  - 1. Title 8, Industrial Relations
  - 2. Title 19, State Fire Marshal Regulations
  - 3. Current California Building Code (CBC), Title 24, Part 2
  - 4. Current California Electrical Code, Title 24, Part 3
  - 5. Current California Mechanical Code, Title 24, Part 4
  - 6. Current California Plumbing Code, Title 24, Part 5
  - 7. Current California Energy Code, Title 24, Part 6
  - 8. Current California Fire Code, Title 24, Part 9
  - 9. Current California Standards Code, Title 24, Part 12
- C. Additional Referenced Standards:
  - 1. AABC Associated Air Balance Council
  - 2. AMCA Air Moving and Conditioning Association
  - 3. AHRI Air-Conditioning, Heating and Refrigeration Institute
  - 4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
  - 5. ASME American Society of Mechanical Engineers
  - 6. ASTM American Society for Testing and Materials
  - 7. NEMA National Electrical Manufacturer's Association
  - 8. NFPA National Fire Protection Association Standards
  - 9. PDI Plumbing and Drainage Institute
  - 10. UL Underwriters Laboratories
- D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Owner's Representative.
- E. Obtain permits, and request inspections from authority having jurisdiction.

### **1.06 PROJECT AND SITE CONDITIONS**

- A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.
- B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.
- C. Examine site related work and surfaces before starting work of any Section.

- D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.
- E. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Owner's Representative before proceeding.

#### **1.07 COOPERATION WITH WORK UNDER OTHER DIVISIONS**

- A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.
- B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.
- C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.
- D. Make such progress in the Work to not delay work of other trades.
- E. Mechanical Work shall have precedence over the other in the following sequence:
  - 1. Soil and waste piping
  - 2. Hydronic piping
  - 3. Ductwork
  - 4. Domestic water piping
  - 5. Fire sprinkler piping

#### **1.08 DISCREPANCIES**

- A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the Owner's Representative of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings.
- B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.
- C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Owner Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

#### **1.09 CHANGES**

- A. The Contractor shall be responsible to make and obtain approval from the Owner's Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

#### **1.10 SUBMITTALS**

- A. Refer to Division 01 for additional requirements.

- B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.
- C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.
- D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Owner's Representative.
- F. Submit all Division 23 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.
- G. Shop Drawings:
  - 1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
  - 2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
  - 3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.
- H. Whenever more than one (1) manufacturer's product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer's products or substitutes may require modifications to the design.
- I. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Owner's Representative bearing the Owner's Representative stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Owner's Representative without additional compensation.
- J. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
- K. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or UL, submit proof of such conformance to the Owner Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Owner Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
- L. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
- M. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications

shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

#### **1.11 PROJECT RECORD DOCUMENTS**

- A. Refer to Division 01 for additional requirements.
  - 1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be redrafted onto the latest version of AutoCAD or Revit, where applicable.
  - 2. Submit completed shop drawings to the Owner prior to completion in AutoCAD format. Contractor hand marked or drafted redlined "Project Record Drawings" will not be accepted.

#### **1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS**

- A. Refer to General Conditions and Division 01 for additional requirements.

#### **1.13 OPERATING INSTRUCTIONS**

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

#### **1.14 MANUFACTURER'S RECOMMENDATIONS**

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

#### **1.15 DELIVERY AND STORAGE**

- A. Refer to Division 01 for additional requirements.
- B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

#### **1.16 GUARANTEE**

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.

- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed.

## **PART 2 PRODUCTS**

Not Applicable.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Owner's Representative.

### **3.02 WORK RESPONSIBILITIES**

- A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.
- B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- 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 extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.
- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Owner immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Owner.
- G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Owner and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.
- H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.

- I. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

### **3.03 PAINTING**

- A. Refer to Division 09 for additional requirements.
- B. Factory Applied:
  1. Mechanical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
  2. Refer to individual sections of this Division for more stringent requirements.
- C. Field Applied:
  1. Paint all mechanical equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
  2. Paint all exposed, uninsulated mechanical piping, valves, supports, hangers and appurtenances. Provide minimum 5 mils dry film thickness.
  3. Paint ductwork flat black that are visible behind air outlets and inlets.
  4. Paint all exposed and rooftop ductwork, roof mounted mechanical equipment, ductwork supports, hangers and appurtenances.
  5. Paint shall be a high performance polyurethane enamel coating system.
    - a. Acceptable paint manufacturers include Ameron, Tnemec or engineer approved equal.
    - b. Acceptable primer manufacturers include Ameron Amershield VOC, Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
    - c. Provide minimum 5 mils dry film thickness.

**END OF SECTION**

**SECTION 23 05 13**  
**COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

**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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.03 QUALITY ASSURANCE**

- A. Bearings: Bearing loads and bearing life shall be determined using AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings, and AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level.
- D. 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.
- E. Motor Efficiency: Motors one horsepower and larger shall exceed current NEMA Premium Efficiency standards.
- F. Structural Seismic Performance: Refer to Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC."

**1.04 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence .
  - 4. Ambient and environmental conditions of installation location.

**1.05 SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All

exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:

1. "No Exception Taken".
  2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each motor, provide operating weights; and manufacturer's technical data on specified features, performance, electrical ratings, and characteristics. Motor performance; percent efficiency, power factor, torque, RPM, power (W) and current vs. percent of rated power output (Horsepower) curves.
- C. Operation and maintenance manual for the motor and installed devices.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
1. U.S. Motors.
  2. General Electric.
  3. Siemens Motors.
  4. Baldor - Reliance.
  5. Westinghouse.
  6. Or equal.
- B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01. Specific procedures must be followed before use of an unnamed product or manufacturer.

### **2.02 GENERAL MOTOR REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.

### **2.03 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.

### **2.04 SINGLE-PHASE MOTORS**

- A. Motor shall be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable.
- B. Motors shall be ECM, variable-speed, DC, brushless motors specifically designed for use with single phase, 60 hertz electrical input as shown on Drawings. Motor shall be complete with and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation.



- C. Motor rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps.
- D. Motor shall be able to be mounted with shaft in horizontal or vertical orientation.
- E. Motor shall be permanently lubricated with ball bearings.
- F. Motor shall maintain a minimum of 70% efficiency over its entire operating range.
- G. Provide manual (or optional remote) fan speed output control as indicated on Drawings for field adjustment of motor speed. Inductors shall be provided to minimize harmonic distortion and line noise.
- H. Overload Protection:
  - 1. Automatic Speed Control: In the event of overheating or overloading, the motor electronics slow the motor to operate within its acceptable range.
  - 2. Thermal Overload: Internally fused, one-shot type as a last resort to prevent fires.
  - 3. Locked Rotor: If the motor sees a locked rotor condition, it will automatically shut itself down, then try to restart 3 times. After the 3rd try, the motor will not attempt to restart until the power is cycled.

## 2.05 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. Enclosure: Totally enclosed fan-cooled (TEFC), cast-iron (may use steel mounting base on 140-T frame series). IEC Protection: IP-44.
- E. VFD Compatibility: "Inverter Ready" per NEMA Standard MG1, Part 31.4.4.2.
  - 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. Insulation: Class F or H insulation, with Class B temperature rise, non-hygroscopic.
  - 3. Shaft Grounding Kit to reduce current flow through bearings, which has damaged many motors on campus.
- F. Variable torque Ratio: 10:1 minimum.
- G. Rotor Balance Requirement: 0.08 Inches per second maximum vibration.
- H. Bearings: Shielded antifriction bearings suitable for application specific radial and thrust loading.
  - 1. The manufacturer's analysis, and selection, shall ensure bearings will have an  $L_{10}$  life of not less than 130,000 hours for direct-drive and not less than 40,000 hours for belt-drive.
  - 2. Bearing styles and types matching special loading requirements. Over-sized bearings as required.
- I. Mounting Feet: Cast-iron precision machined flatness for accurate motor base mounting alignment per NEMA MG1.
  - 1. Foot-to-foot flatness from mounting hole to mounting hole shall not exceed 0.005 inches.
- J. Conduit Boxes: Shall be over-sized NEMA, gasketed, repositionable box for field conduit routing adjustment, with grounding connection.

- K. Lifting Lugs: For frame sizes 215 and above, permanent lifting provisions, such as eye bolts, shall be provided.

## **2.06 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS**

- A. Outdoor Applications: For outdoor applications provide “rain-proof” motors with options listed below Outdoor motor features listed below offer better environmental enclosure protection, and are in “addition to the required features” of protected indoor motors:
  - 1. IEC Ingress Protection Rating: IP-54.
  - 2. Epoxy paint on enclosure and rotor.
  - 3. Shaft slingers.
  - 4. Stainless steel nameplate and hardware.
- B. 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.

## **2.07 SHAFT GROUNDING RINGS**

- A. Manufacturers:
  - 1. Electro Static Technology Inc. - Aegis SGR product line.
  - 2. Inpro/Seal, a division of Waukesha Bearings Corporation - CDR product line.
  - 3. Or equal.
- B. Description: Circumferential micro-fiber ring with metal frame, designed to conduct VFD induced bearing currents from the motor shaft to ground. Provides protection recommended in NEMA MG 1. Provide with mounting kit including bolts and bracket, or conductive epoxy to adhere to motor casing, to ensure ground connection from the SGR to the motor frame.
- C. Provide SGRs on at least one end of the motor.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, maintenance clearances and other conditions affecting performance.
- B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 MOTOR INSTALLATION**

- A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align motor with base. Align motors, bases, shafts, pulleys and belts with driven equipment, or couplers. Tension belts according to manufacturer's written instructions.
- B. Comply with mounting and anchoring requirements specified in Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC."

- C. Connect motor leads to power source using rings and bolts or split bolts as needed. Insulation of connected motor leads shall be of the highest quality and designed to withstand the same temperature as the internal windings. Ordinary electrical tape is not generally suitable for this service and shall not be used as the only means of insulation. Wire nuts are prohibited.
- D. Motor power leads shall be marked at the source and at the connection box on the motor.

### **3.03 FIELD QUALITY CONTROL**

- A. Prepare for acceptance tests as follows:
  - 1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  - 2. Test interlocks and control features for proper operation.
  - 3. Verify that current in each phase is within nameplate rating.
- B. Testing: Owner's Representative may engage a qualified testing agency to perform the following field quality-control testing:
  - 1. Perform each electrical test and visual and mechanical inspections stated in NETA ATS, Section 7.15.1 and certify compliance with test parameters.
- C. After the Owner's testing agency is finished, correct any malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and the University shall retest.

### **3.04 CLEANING**

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

**END OF SECTION**



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

**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. 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. Division 05 Section 05 12 00 "Structural Steel" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
  - 3. Division 23 Section 23 31 13 "Metal Ducts" for duct hangers and supports.

**1.03 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

**1.04 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 ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### **1.05 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.
- D. 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.

### **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, provide products by one of the following:
  - a. B-line, an Eaton Company
  - b. Flex-Strut Inc.
  - c. Wesanco Inc.
  - d. Unistrut ; Atkore International
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: Hot-dipped galvanized.
8. Paint Coating: Acrylic.
9. Plastic Coating: Polyurethane.

### **B. Non-MFMA Manufacturer Metal Framing Systems:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International; a subsidiary of Mueller Water Products Inc.
  - b. Haydon Corporation; H-Strut Division.
  - c. PHD Manufacturing, 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.
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. Coating: Zinc.

## **2.04 THERMAL-HANGER SHIELD INSERTS**

### **A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Rilco manufacturing Co..
2. Piping technology & Products Inc..
3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

4. Value Engineered products Inc.
- B. Insulation-Insert Material for Cold Piping: 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 C 533, 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.

## **2.05 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## **2.06 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 plastic 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non-staining, 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 powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- 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 Division 07 Section 07 72 00 "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.
  5. 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 exterior painting Section 09 91 13.
- 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 Section 23 23 00 specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Section 23 23 00.

- 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 padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Section 23 23 00, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 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 non-insulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 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.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Section 232300, 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.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Section 23 23 00, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Section 23 23 00, 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.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Section 23 23 00, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Section 23 23 00, 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.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Section 23 23 00.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Section 23 23 00.
- P. Use powder-actuated fasteners or 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 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. Elastomeric isolation pads.
  2. Housed-spring isolators.
  3. Spring hangers.
  4. Restraint channel bracings.
  5. Restraint cables.
  6. Seismic-restraint accessories.
  7. Mechanical anchor bolts.
  8. Adhesive anchor bolts.
  9. Vibration isolation equipment bases.
  10. Restrained isolation roof-curb rails.

##### 1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

##### 1.04 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 an evaluation by an approved agency acceptable to authorities having jurisdiction.
    - 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. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select vibration isolators and seismic restraints and for designing vibration isolation bases.
    - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
  3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
  4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Section 23 05 29 for equipment mounted outdoors.

#### **1.05 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.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- E. Field quality-control reports.

## 1.06 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 IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

## PART 2 PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Contractor shall consult on requirements with Structural Engineer of Record or other acceptable qualified engineer by the authority having jurisdiction.

### 2.02 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads.
  - 1. Manufacturer and Model No:
    - a. Basis of Design
      - 1) Mason Industries Type MBSW
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
  - 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: Waffle pattern.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric

### 2.03 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators.

1. Manufacturer and Model No
  - a. Basis of Design
    - 1) Mason Industries Type SLFH
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. 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.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

#### **2.04 HOUSED-SPRING ISOLATORS**

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing.
  1. Manufacturer and Model No:
    - a. Basis of Design
      - 1) Mason Industries Type C
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
  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, threaded mounting holes and internal leveling device.

#### **2.05 SPRING HANGERS**

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

1. Manufacturer and Model No:
  - a. Basis of Design
    - 1) Mason Industries Type 30N OR PC30NS
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
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.

## **2.06 RESTRAINT CHANNEL BRACINGS**

- A. Manufacturer and Model No:
  1. Basis of Design
    - a. Mason Industries Type Seismic Sway Bracing System
  2. Or Approved Equal by:
    - a. California Dynamics Corporation
    - b. Kinetics Noise Control
    - c. Vibrex
- 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.

## **2.07 RESTRAINT CABLES**

- A. Manufacturer and Model No:
  1. Basis of Design
    - a. Mason Industries Type SCBA Assembly, SCR, UC & CCB
  2. Or Approved Equal by:

- a. California Dynamics Corporation
  - b. Kinetics Noise Control
  - c. Vibrex
- B. Restraint Cables: ASTM A 603 galvanized ASTM A 492 stainless-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.

## **2.08 SEISMIC-RESTRAINT ACCESSORIES**

- A. Manufacturer and Model No:
- 1. Basis of Design
    - a. Mason Industries Type SCR, UC & CCB
  - 2. Or Approved Equal by:
    - a. California Dynamics Corporation
    - b. Kinetics Noise Control
    - c. Vibrex
- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## **2.09 MECHANICAL ANCHOR BOLTS**

- A. Manufacturer and Model No:
- 1. Basis of Design
    - a. Mason Industries Type SAB/SAS
  - 2. Or Approved Equal by:
    - a. California Dynamics Corporation
    - b. Kinetics Noise Control
    - c. Hilti
- 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.

## **2.10 ADHESIVE ANCHOR BOLTS**

- 1. Basis of Design
  - a. Mason Industries Type SAA

2. Or Approved Equal by:
  - a. California Dynamics Corporation
  - b. Kinetics Noise Control
  - c. Hilti
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.11 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
  1. Manufacturer and Model No:
    - a. Basis of Design
      - 1) Mason Industries Type RND Rails
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
  2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
    - a. Include supports for suction and discharge elbows for pumps.
  3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
  4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
  1. Manufacturer and Model No:
    - a. Basis of Design
      - 1) Mason Industries Type MSL
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
  2. 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.
  3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

## **2.12 RESTRAINED SEISMICALLY ISOLATION ROOF-CURB RAILS**

- A. Manufacturer:
  1. Basis of Design
    - a. Mason Industries
  2. Or Approved Equal by:
    - a. California Dynamics Corporation
    - b. Kinetics Noise Control
- B. Vibrex Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.
- C. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces.
- D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

## **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. 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.



- B. 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 03 30 00 "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 07 72 00 "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.
- 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 bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. 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.
- I. 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.
- J. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.04 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.

### **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 Structural Engineer of Record.
  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.
  9. Test and adjust restrained-air-spring isolator controls and safeties.
- 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 AIR-SPRING ISOLATOR INSTALLATION**

#### **A. Independent Isolator Installation:**

1. Install tank valve into each air isolator.
2. Inflate each isolator to height and pressure specified on Drawings.

#### **B. Pressure-Regulated Isolator Installation:**

1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections
2. Connect all pressure regulators to a single dry, filtered facility compressed air supply.
3. Inflate isolators to height and or pressure specified on Drawings.

### **3.08 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 03 30 00 "Cast-in-Place Concrete."

**END OF SECTION**



**SECTION 23 05 53**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

**1.03 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
- C. Samples: For color, letter style, and graphic representation required for each identification material and device.
- D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

**1.04 COORDINATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. Manufacturers:
  - 1. Craftmark Identification Systems
  - 2. Seton Identification Products
  - 3. MSI Marking Services
  - 4. Setmark

### **2.02 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass or anodized aluminum, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum 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.
  - 4. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Material and Thickness: Three-layer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick and having predrilled holes for attachment hardware.
  - 2. Color Coding:
    - a. Letter Color: White.
    - b. Background Color: Red.
  - 3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 6. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus 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), plus the Specification Section number

and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

### **2.03 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Color Coding:
  - 1. Background Color: Yellow.
  - 2. Letter Color: Black.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch 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.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

### **2.04 PIPE LABELS**

- A. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pre-tensioned Pipe Labels for Outside Diameter Less or Equal to 8 Inches: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels for Outside Diameter Greater than 8 Inches: Printed plastic with contact-type, permanent-adhesive backing. Either marker shall show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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 1-1/2 inches high.

### **2.05 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- D. 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.
- E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.06 STENCILS

- A. Stencils for Piping: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/8 inch for access panel and door labels, equipment labels and similar operational instructions.
  - 1. Stencil Material: Brass
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel, black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.
- B. Stencils for Ducts:
  - 1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
  - 2. Stencil Material: Brass.
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
- C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  - 1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
  - 2. Stencil Material: Brass
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

## 2.07 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 3/8-inch letters for piping system abbreviation and 1/2 inch sequenced numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.



- B. 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.

## **2.08 WARNING TAGS**

- A. Warning Tags: 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:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

## **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 Division 9.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within one foot of each valve and control device.
  - 2. Near each branch connection and riser takeoff.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. Near major equipment items and other points of origination and termination.

5. At access doors, manholes, and similar access points that permit view of concealed piping.
  6. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
  7. On piping above removable acoustical ceilings.
- 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. Refrigerant Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

### 3.05 DUCT LABEL INSTALLATION

- A. Locate ductwork labels where ductwork is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within one foot of each control device.
  2. Near each branch connection and riser takeoff.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. Near major equipment items and other points of origination and termination.
  5. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
  6. On ductwork above removable acoustical ceilings.
- B. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
1. Exhaust Air Ducts:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.
  2. Supply Air, Return Air and Outside Air:
    - a. Background Color: Blue.
    - b. Letter Color: White
  3. Return Air and Outside Air:
    - a. Background Color: Green.
    - b. Letter Color: White
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

### 3.06 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections. 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. Refrigerant: 2 inches, round.

2. Valve-Tag Color:
    - a. Refrigerant: Natural.
  3. Letter Color:
    - a. Refrigerant: Black.
- C. All above and below grade and interior and exterior valves shall be tagged. Submit valve tag chart to the Owner Representative for review and approval at the completion of the project.

### **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 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. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Testing, Adjusting, and Balancing Equipment:
    - a. Heat exchangers.
    - b. Motors.
    - c. Condensing units.
    - d. Heat-transfer coils.
  - 3. Testing, adjusting, and balancing existing systems and equipment.
  - 4. Sound tests.
  - 5. Vibration tests.
  - 6. Duct leakage tests.
  - 7. Control system verification.

**1.03 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

**1.04 PREINSTALLATION MEETINGS**

- A. TAB Conference: Conduct a TAB conference at Project site with the Engineer and Commissioning Agent after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:
  - a. The Contract Documents examination report.
  - b. The TAB plan.
  - c. Needs for coordination and cooperation of trades and subcontractors.
  - d. Proposed procedures for documentation and communication flow.

#### **1.05 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  1. "No Exception Taken".
  2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. TAB Report:
  1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
  2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

#### **1.06 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  1. Instrument type and make.
  2. Serial number.
  3. Application.
  4. Dates of use.
  5. Dates of calibration.

## 1.07 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Engage an independent TAB Contractor certified by AABC, NEBB or TABB.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## 1.08 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, flow-control devices, valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and 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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. 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.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine air zone controllers, such as variable-air-volume, multi-zone duct zone coil/damper assemblies, and verify that they are accessible and their controls are connected and functioning.
- K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.02 PREPARATION**

- A. Prepare a TAB plan that includes the following:
  1. Equipment and systems to be tested.
  2. Strategies and step-by-step procedures for balancing the systems.
  3. Instrumentation to be used.
  4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Automatic temperature-control systems are operational.
    - g. Ceilings are installed.
    - h. Windows and doors are installed.
    - i. Suitable access to balancing devices and equipment is provided.



### **3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE Standard 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- 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, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct 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. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. 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.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

### **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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

- c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Obtain approval from Owner 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.
  5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
  1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.
  3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
  4. Mark all final settings.
  5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  6. Measure and record all operating data.

7. Record final fan-performance data.

### 3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
  1. Verify that the system static pressure sensor is located at least two-thirds of the distance down the duct from the fan discharge or as shown on the Drawings.
  2. Verify that the system is under static pressure control.
  3. Select the AHU multi-zone, damper / coil assembly that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical multi-zone AHU damper / coil assembly 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.
  4. Calibrate and balance each multi-zone AHU damper / coil assembly for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    - c. When maximum airflow is correct, balance the air outlets downstream from the AHU multi-zone, damper / coil assembly.
    - d. Adjust controls so that terminal is calling for minimum airflow.
    - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
  5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  6. Measure fan static pressures as follows:

- a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.
  - c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - b. Verify that AHU multi-zone, damper / coil assemblies are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical AHU multi-zone, damper / coil assembly and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.
  - g. Verify building pressurization control by measuring building pressure at various operating conditions.

### **3.07 PROCEDURES FOR CONDENSING UNITS**

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

### **3.08 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.

### **3.09 SOUND TESTS**

- A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 7 locations as designated by the Architect.
- B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
  2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
  3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
  4. The accuracy of the sound-testing meter shall be plus or minus one decibel.
- C. Test Procedures:
1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
  2. Equipment should be operating at design values.
  3. Calibrate the sound-testing meter prior to taking measurements.
  4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
  5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
  6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
  7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
  8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.
- D. Reporting:
1. Report shall record the following:
    - a. Location.
    - b. System tested.
    - c. dBA reading.
    - d. Sound pressure level in each octave band with equipment on and off.
  2. Plot sound pressure levels on NC worksheet with equipment on and off.

### **3.10 VIBRATION TESTS**

- A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 25.
- B. Instrumentation:
1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
  2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
  3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.

4. Verify calibration date is current for vibration meter before taking readings.
- C. Test Procedures:
1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
  2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
  3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
  4. Record CPM or rpm.
  5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.
- D. Reporting:
1. Report shall record location and the system tested.
  2. Include horizontal-vertical-axial measurements for tests.
  3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
  4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

### **3.11 DUCT LEAKAGE TESTS**

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

### **3.12 CONTROLS VERIFICATION**

- A. In conjunction with system balancing, perform the following:
  1. Verify temperature control system is operating within the design limitations.
  2. Confirm that the sequences of operation are in compliance with Contract Documents.
  3. Verify that controllers are calibrated and function as intended.
  4. Verify that controller set points are as indicated.
  5. Verify the operation of lockout or interlock systems.
  6. Verify the operation of valve and damper actuators.
  7. Verify that controlled devices are properly installed and connected to correct controller.
  8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.

9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### **3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS**

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
  2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  3. Check the refrigerant charge.
  4. Check the condition of filters.
  5. Check the condition of coils.
  6. Check the operation of the drain pan and condensate-drain trap.
  7. Check bearings and other lubricated parts for proper lubrication.
  8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
  2. Coils are clean and fins combed.
  3. Drain pans are clean.
  4. Fans are clean.
  5. Bearings and other parts are properly lubricated.
  6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.

### **3.14 TOLERANCES**

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 percent or minus 0 percent.
  2. Air Outlets and Inlets: Plus or minus 10 percent.
  3. Heating-Water Flow Rate: Plus or minus 10 percent.
  4. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### **3.15 PROGRESS REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### **3.16 FINAL REPORT**

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. 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. Architect's name and address.



6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for AHU multi-zone AHU damper / coil assemblies, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  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. AHU multi-zone, damper / coil assemblies.
  6. Balancing stations.
  7. Position of balancing devices.
- E. 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.
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. 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. Outdoor-air damper position.
  - l. Return-air damper position.
  - m. Vortex damper position.
- F. 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. Airflow 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. Refrigerant expansion valve and refrigerant types.
  - i. Refrigerant suction pressure in psig.
  - j. Refrigerant suction temperature in deg F.
- G. 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.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft.
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.

- I. AHU multi-zone, damper / coil assembly:
  - 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. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
  - 3. Test Data (Indicated and Actual Values):
    - a. Airflow 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.
- J. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### **3.17 VERIFICATION OF TAB REPORT**

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.
- B. Commissioning authority 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.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Owner may contact AABC, NEBB or TABB Headquarters regarding the Performance Guaranty.
- F. Prepare test and inspection reports.

### **3.18 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. 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 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Review these documents for coordination with additional requirements and information that apply to work under this Section

#### **1.02 SUMMARY**

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.

#### **1.03 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail 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.

#### **1.04 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.

### **1.05 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.

### **1.06 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.

### **1.07 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### **1.08 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. Products shall not contain asbestos, lead, mercury, or mercury compounds.



- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. 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, provide products by one of the following:
    - a. CertainTeed Corporation; SoftTouch Duct Wrap
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Owens Corning; SOFTR All-service Duct Wrap.

## **2.02 FIRE-RATED INSULATION SYSTEMS**

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. 3M
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. Morgan Thermal Ceramics
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Mon-Eco Industries, Inc.

## **2.03 MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller
    - c. Knauf Insulation.
  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 Permeance: ASTM 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
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.; CP10
    - b. Eagle Bridges - Marathon Industries.; 550
    - c. Foster Brand; H. B. Fuller Construction Products.; 146-50
  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 SEALANTS**

- A. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.; CP-76.
    - b. Foster Brand; H. B. Fuller Construction Products.; 95-44.
    - c. Mon-Eco Industries, Inc.; 44-05
    - d. Eagle Bridges – Marathon Industries; 405.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: 20 to plus 250 deg F.
  5. Color: Aluminum.

6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

## **2.05 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, provide products by one of the following:
    - a. Childers.
    - 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
      - 2) ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      - 3) RPR Products, Inc.; Insul-Mate.
  3. Factory cut and rolled to size.
  4. Finish and thickness are indicated in field-applied jacket schedules.
    - a. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - b. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.

## **2.06 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, provide products by one of the following:
    - a. Compac Corporation; 110 and 111.
    - b. ABI, Ideal Tape Division; 491 AWF FSK.
    - c. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
    - d. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  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.

## 2.07 SECUREMENTS

### A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ITW Insulation Systems; Illinois Tool Works, Inc.; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
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.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Midwest Fasteners or approved equal.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

### B. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide product by:
  - a. C & F Wire, or equal.

## 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.

### 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 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.

### **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: 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 "Penetration Firestopping."
- E. 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 "Penetration Firestopping."

### 3.05 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 50 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 over compress 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 un-faced 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.

### **3.06 FIELD-APPLIED JACKET INSTALLATION**

- A. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- 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.

### **3.07 FIRE-RATED INSULATION SYSTEM INSTALLATION**

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 07 84 00 "Penetration Firestopping."

### **3.08 FINISHES**

- A. Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting"
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### **3.09 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply.
  - 2. Indoor, exposed supply.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
- B. Items Not Insulated:
  - 1. Metal ducts with duct liner of sufficient thickness to comply with Title 24 energy code.
  - 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.

### **3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Supply and return air duct and plenum insulation shall be the following:
  1. Mineral-Fiber Blanket: 1.5 inches thick and 0.75-lb/cu. ft. nominal density.

**END OF SECTION**



**SECTION 23 08 00**  
**MECHANICAL SYSTEMS COMMISSIONING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. The purpose of this section is to specify Division 23 and 25 responsibilities, Division 22 responsibilities, and Division 32 responsibilities in the commissioning process.

**1.02 RESPONSIBILITIES**

- A. Mechanical, Controls and Test and Balance (TAB) subcontractors: The commissioning responsibilities applicable to each of the subcontractors are as follows (all references apply to commissioned equipment only):
1. Attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
  2. Provide the commissioning agent with normal cut sheets and submittals of commissioned equipment.
  3. Provide additional requested documentation, prior to normal O&M manual submittals, to the commissioning agent for development of start-up and functional testing procedures.
  4. Provide a copy of the O&M manuals and submittals of commissioned equipment to the commissioning agent for review.
  5. Sub-Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
  6. Sub-Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
  7. Execute the mechanical and electrical-related portions of the pre-functional checklists for all commissioned equipment.
  8. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the commissioning agent.
  9. Address current Engineer of Record punch list items before functional testing. TAB shall be completed with discrepancies and problems remedied before functional testing.
  10. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests for sufficient duration to complete the necessary tests, adjustments and problem-solving.
  11. Correct deficiencies identified by the commissioning agent, Owner's Representative and Engineer of Record and retest the equipment.
  12. Prepare O&M manuals according to the Contract Documents.
  13. Provide training of the Owners Representative's operating staff.

14. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- B. Mechanical Contractor. The responsibilities of the mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Provide startup for all HVAC equipment.
  2. Assist and cooperate with the TAB contractor and commissioning agent by:
    - a. Putting all HVAC equipment and systems into operation as required.
    - b. Including cost of sheaves and belts that may be required by TAB.
    - c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.
    - d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
  3. Prepare a preliminary schedule for Division 23 pipe system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the commissioning agent. Update the schedule as appropriate.
  4. Notify the Owner's Representative when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur.
  5. Assist with functional testing on locally controlled equipment not part of the central building automation system.
- C. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications.
  2. Control Drawings Submittal.
    - a. The control drawings shall have a key to all abbreviations.
    - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
    - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
    - d. Provide a full points list
    - e. The Controls Contractor shall keep the commissioning agent informed of all changes to this list during programming and setup.
  3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
  4. Assist and cooperate with the Testing, Adjusting and Balancing (TAB) contractor in the following manner:

- a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments that may be needed.
  - b. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the commissioning agent prior to TAB.
  - c. Provide a qualified technician to operate the controls to assist the TAB contractor.
5. Assist and cooperate with the commissioning agent in the following manner:
- a. Execute the functional testing of the controls system. Assist in the functional testing of all equipment to be commissioned. Provide two-way radios during the testing.
  - b. Execute all control system trend logs.
6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing.
7. Provide a signed and dated certification to the commissioning agent and Owner's Representative upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Design Intent and Contract Documents, except functional testing requirements.
8. As well as the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points.
9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
10. The controls contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. The controls work is not complete until the commissioning agent and the University has signed off on the commissioned systems
- D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:
- 1. Submit the outline of the TAB plan and approach for each system and component to the commissioning agent, Owner's Representative and the controls contractor six weeks prior to starting the TAB.
  - 2. The submitted plan will include:
    - a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
    - b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
    - c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

- e. Final test report forms to be used.
  - f. Detailed step-by-step procedures for TAB work for each system.
  - g. List of all measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
  - h. Details of how total flow will be determined.
  - i. The identification and types of measurement instruments to be used and their most recent calibration date.
  - j. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
3. A running log of events and issues shall be kept by the TAB field technicians.
  4. Communicate in writing to the General Contractor and the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
  5. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.
  6. Provide the commissioning agent with any requested data, gathered, but not shown on the draft reports.
  7. Provide calibrated instruments to assist commissioning agent in conducting calibration checks of sensors and any other devices requiring field checkout.
  8. Provide a final TAB report for the commissioning agent with details.
  9. Conduct functional performance tests and checks on the original TAB.
  10. The test and balance contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. This includes assistance with reading airflows, water flows, taking pressure measurements, temperature measurements, and providing any other readings requested by the commissioning agent related to the commissioned equipment.
  11. The TAB work will not be complete until signed off by commissioning agent and Owner.

## **PART 2 PRODUCTS**

### **2.01 TEST EQUIPMENT**

- A. Divisions 22, 23, 25 and 32 shall provide all test equipment necessary to fulfill the testing requirements.

## **PART 3 EXECUTION**

### **3.01 STARTUP**

- A. Divisions 22, 23, 25 and 32 have start-up responsibility and are required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen

this responsibility or shift that responsibility partially to the commissioning agent or Owner's Representative.

- B. Functional testing is intended to begin upon completion of a system.

### **3.02 FUNCTIONAL TESTING**

- A. This section presents representative functional testing requirements for Division 23 and 32 systems and equipment.
- B. Parties Responsible to Execute Functional Test
  - 1. Controls contractor shall operate the controls as needed.
  - 2. Test and balance contractor shall take readings and assist with set up of equipment. HVAC mechanical contractor or vendor shall assist in testing sequences as needed.
  - 3. CxA shall witness, direct and document testing.
- C. Testing and Acceptance criteria
  - 1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned.
  - 2. Ability of system to maintain the temperature and humidity range within prescribed tolerance
  - 3. All alarms
  - 4. For the conditions, sequences and modes tested, the BAS, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice
- D. Required Monitoring
  - 1. All points requested by the CxA shall be trended by the controls contractor. The trending shall be for seven (7) days per week, 24 hours per day at five minute intervals or as requested by the CxA.
- E. BAS Functional Testing
  - 1. A significant part of the BAS functional testing requirements is the successful completion of the functional tests of equipment the BAS controls or interlocks with. Uncompleted equipment functional tests or outstanding deficiencies in those tests lend the required BAS functional testing incomplete.
  - 2. Integral or stand-alone controls are functionally tested with the equipment they are attached to, including any interlocks with other equipment or systems.
  - 3. In addition to the controlled equipment testing, the following tests are required for the BAS, where features have been specified. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in the specifications.
    - a. All specified functions and features are set up, debugged and fully operable
    - b. Power failure and battery backup and power-up restart functions if applicable
    - c. Global commands features
    - d. Security and access codes

- e. Occupant over-rides (manual, telephone, key, keypad, etc.)
- f. O&M schedules and alarms if applicable
- g. Scheduling features fully functional and setup, including holidays
- h. Date and time setting in central computer and verify field panels read the same time
- i. Demonstrate functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad
- j. All graphic screens and value readouts completed
- k. Set-point changing features and functions
- l. Sensor calibrations
- m. Final as-builts or redlines (per spec) control drawings, final points list, program code, set-points, schedules, warranties, etc. per specs, submitted for O&Ms.
- n. Verify that points that are monitored only, having no control function, are checked for proper reporting to BAS.
- o. Communication time between network controllers and field controllers.
- p. Labeling of points.

### **3.03 WRITTEN WORK PRODUCTS**

- A. Written work products will consist of the filled out start-up, initial checkout and pre-functional checklists.

**END OF SECTION**



**SECTION 23 09 23**  
**DIRECT DIGITAL CONTROL SYSTEM FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Building Management System (BMS), utilizing direct digital controls.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Products Installed But Not Supplied Under This Section:
1. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
- B. Products Installed But Not Supplied Under This Section:
1. None.
- C. Products Not Furnished or Installed But Integrated with the Work of This Section:
1. VRF system manufacturers BACnet IP integration & communications devices.
  2. Existing BAS Graphics & IVC Existing BASview network integration.
- D. Work Required Under Other Divisions Related to This Section:
1. 120v Power wiring to all control panels. All wiring & conduit above 120v.
  2. Campus LAN (Ethernet) connection adjacent to existing and new BASview network management controller & KMC ms/tp router.
  3. Furnish & Installing components & controls associated with 3<sup>rd</sup> party manufacturers.

**1.03 SYSTEM DESCRIPTION**

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over the existing BACnet IP protocol.
1. The existing Imperial Valley College campus DDC System is KMC BACnet IP and CATnet CH-2 BASview Operator Workstation. All DDC Controls shall be furnished and installed by Building Automation Systems, Inc. 858-309-2022.
  2. OWS software requiring licensing fees or software programming tool ownership fees is SPECIFICALLY PROHIBITED and will be rejected.
  3. The intent of this specification is to provide a system consistent with existing KMC DDC system throughout the owner's facilities utilizing the CH-2 BASview Framework.
  4. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including BACnet
  5. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers

from any computer on the owner's LAN.

6. All control devices furnished with this Section shall be programmable directly from the EXISTING KMC and CATnet Ch-2 BASview software upon completion of this project. The use of configurable or programmable controllers that require additional software tools or tools that require a specific license brand to operate for post-installation maintenance are not acceptable.
7. Any control vendor who provides additional BMS software shall be UNACCEPTABLE. Only systems that utilize the CATnet CH-2 BASview Framework shall satisfy the requirements of this section.
8. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus CATnet CH-2 BASview server.
9. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance & operation of the BMS indefinitely.
10. All BASview, CH-2 & CATnet hardware SHALL NOT REQUIRE licenses and related certificates & license fees of any type.
11. To ensure quality, all CATnet CH-2 BASview products used on this project shall be provided by Building Automation Systems, Inc. Ph: 858-309-2022. Hardware products not meeting this requirement WILL NOT be allowed.

#### **1.04 SPECIFICATION NOMENCLATURE**

- A. Acronyms used in this specification are as follows:
  1. AI: Analog Input.
  2. AO: Analog Output.
  3. Analog: Continuously variable state over stated range of values.
  4. BMS: Building Management System.
  5. DDC: Direct Digital Control.
  6. Discrete: Binary or digital state.
  7. DI: Discrete Input.
  8. DO: Discrete Output.
  9. GUI: Graphical User Interface.
  10. HVAC: Heating, Ventilating and Air Conditioning.
  11. IDC: Interoperable Digital Controller.
  12. LAN: Local Area Network.
  13. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
  14. Motorized: Control device with actuator.

15. NAC: Network Area Controller.
16. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
17. Operator: Same as actuator.
18. PC: Personal Computer.
19. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
20. PICS: BACnet Product Interoperability Compliance Statement.
21. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
22. Point: Analog or discrete instrument with addressable database value.
23. WAN: Wide Area Network.

#### **1.05 SUBMITTALS**

- A. 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.
- B. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- C. 4 copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- D. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- E. Upon completion of the work, provide 2 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and on Flash media.
- F. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

#### **1.06 QUALITY ASSURANCE**

- A. Single Source Responsibility of Supplier: Building Automation Systems, Inc., shall be responsible for the complete installation and proper operation of the control system. Building Automation Systems, Inc. is exclusively in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized

- representative for the primary DDC components manufacturer for at least 15 years.
- B. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems.

### **1.07 JOB CONDITIONS**

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. KMC Controls & CATnet Systems CH-2 BASview furnished & installed by Building Automation Systems, Inc., 858-309-2022. The existing, campus-wide DDC system is manufactured by KMC and CATnet System Servers and Operator Workstation.
- B. Substitutions: Not permitted.

### **2.02 GENERAL**

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed hardware & software shall be identical to the existing installed system utilizing the same hardware & software as the existing campus system as installed by Building Automation Systems, Inc., utilizing the existing DDC System network components.

### **2.03 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE**

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. Physical connection of any BACnet control equipment shall be via Ethernet or IP. Any BACnet IP interface(s) shall be furnished & installed by others.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable. System shall utilize BACnet IP communications.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Servers and data shall reside on the Operating System Server located in Building 400 BMS wall mounted Server Rack on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

### **2.04 BAS SERVER HARDWARE**

- A. Minimum Server Configuration:

1. Central Web Server. Contractor shall provide a dedicated Web Graphics server for each building in this project. Servers as manufactured by CATnet Systems.
  2. Memory: 1 GB or more recommended for large systems, 8 GB or more recommended for the Windows 64-bit version.
  3. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
- B. Standard Client Browser: Windows Chrome, Android: Chrome, iPhone/iPad/Mac: Safari, Linux: Chrome.

## **2.05 SYSTEM NETWORK CONTROLLER (SNC)**

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its BACnet Ethernet Network, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS.
- B. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- C. The communication protocols utilized for peer-to-peer communications between SNC's will be BACnet TCP/IP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is NOT ALLOWED.
- D. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
  1. BACnet IP
- E. The SNC shall be capable of executing application control programs to provide:
  1. Calendar functions.
  2. Scheduling.
  3. Trending.
  4. Alarm monitoring and routing.
  5. Time synchronization.
  6. Integration of BACnet IP, ms/tp, MAMAC & MODBUS controller data.
- F. The SNC shall provide the following hardware features as a minimum:
  1. One 10/100 Mbps Ethernet port.
  2. 1 GB SDRAM
  3. USB Flash Drive
  4. Plugin 120V to 24 VAC/DC Power Supply
- G. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 100 simultaneous users.
- H. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- I. The SNC shall be able to route any alarm condition to any defined user location whether

connected to a local network or remote via cellular modem, or wide-area network.

1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
    - a. Alarm.
    - b. Return to normal.
    - c. To default.
  2. Alarms shall be annunciated in any of the following manners as defined by the user:
    - a. Screen message text.
    - b. Email of complete alarm message to multiple recipients.
    - c. Pagers via paging services that initiate a page on receipt of email message.
    - d. Graphics with flashing alarm object(s).
  3. The following shall be recorded by the SNC for each alarm (at a minimum):
    - a. Time and date.
    - b. Equipment (air handler #, access way, etc.).
    - c. Acknowledge time, date, and user who issued acknowledgement.
- J. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- K. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD...) shall have an associated template file for reuse on future project additions.
- L. The SNC shall be provided with a NO COST Software License. NO LICENSING FEES OF ANY KIND IS ACCEPTABLE.

## **2.06 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC) BY KMC CONTROLS**

- A. General: Controllers shall be responsible for monitoring and controlling directly connected HVAC and Lighting equipment and other building automation systems as required. Each controller shall be classified as a "native" BACnet device, supporting the BACnet Advanced Application Controllers (B-AAC) profile. Controllers that support a lesser profile such as B-ASC are not acceptable. Controllers shall conform to the BACnet Advanced Application Controller (B-AAC) profile.
- B. Software Specifications
1. General: The controller shall contain non-volatile memory to store both the resident operating system and application programming. Any program may affect the operation of any other program. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, extraction of the program for storage, routing communications, etc.
  2. Automatic Restart after Power Failure: Upon restoration of power after an outage, the controller shall automatically and without human intervention update all monitored functions; resume operation based on current synchronized time and status, and implement special start-up strategies as required.

3. User Programming Language: The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. Controllers shall be capable of utilizing both line code based programming and Graphical Function Block programming interfaces.
  - a. Programs shall be generated by an English-language based (line) editor or a Graphical Function Block interface.
  - b. The language shall be structured to allow for the easy configuration of control programs and mathematical calculations.
  - c. Controllers that use non-editable factory programming only method will not be accepted.
4. Energy Management Applications: The controller shall have the ability to perform any or all of the following energy management routines:
  1. Time of Day Scheduling
  2. Calendar Based Scheduling
  3. Holiday Scheduling
  4. Exception Scheduling
  5. Temporary Schedule Overrides
  6. Optimal Start
  7. Optimal Stop
  8. Night Setback Control
  9. Enthalpy Switchover (Economizer)
  10. Temperature Compensated Duty Cycling
  11. CFM Tracking
  12. Demand Ventilation
- C. History Logging: Each controller shall be capable of locally logging any input, output, calculated value, etc. over user defined time intervals (1 second minimum time).
- D. Alarm Management: For each system point, alarms can be created based on high/low limits or conditional expressions. A minimum of 255 priority levels shall be provided. If communication with the Operator Workstation is temporarily interrupted, the alarm will be time-stamped and buffered in the controller. When communications return, the alarm will be transmitted to the Operator Workstation.
- E. Communications: The controllers shall be a native BACnet communications, available as EIA-485 (MS/TP) or Ethernet/IP physical connections as required. The controller shall be capable of communication to both the Workstation(s) and the field buses.
  1. MS/TP Devices: For devices with MS/TP connectivity, baud rates between 9600 and 115.2k baud shall be selectable.
  2. This project requires BACnet IP as the communication protocol. No exceptions.
- F. Dedicated Room Sensor Port: The controller shall have a Dedicated Room Sensor port for direct interface to a Digital Room Sensor or Discrete Room Sensor. The controller shall have the ability of detecting if a sensor has been connected to the port and identify its

type.

- G. Firmware Upgrades: The controller firmware shall be upgradeable for updates as future enhancements and expanded functionality. Firmware updates shall be supported via BACnet communications (over-the-network) and ALWAYS offered at NO COST.
- H. Hardware Platform Features:
  - 1. Processor: The controller shall employ at minimum a 32-bit microprocessor.
  - 2. Memory: The operating system and the application programs for the controller shall be stored in non-volatile FLASH memory. The controller shall support up to 8 MB Flash memory and up to 2 MB of RAM. The controller shall include an on-board capacitor to back up the controller's RAM memory for a period of at least six hours. In the case of a power failure, the controller shall first try to restart from the RAM memory. If that memory is corrupted or unusable, then the controller shall restart itself from its application program stored in its FLASH memory.
  - 3. Network Communication Ports: The controller shall have on-board, dual 10/100bT Ethernet port or an EIA-485 port. The dual Ethernet connections shall function as an Ethernet hub, allowing daisy-chained Ethernet topologies. The EIA-485 port shall have network protection bulbs and integrated end-of-line (EOL) terminations.
  - 4. Dedicated Room Sensor Port: The controller shall have a dedicated room sensor port to directly connect a Digital Room Sensor or Discrete Room Sensor (supporting both room temperature and room setpoint). Sensors shall be hot-swappable without powering down the controller.
  - 5. Inputs: The controller shall have on-board universal inputs with a minimum of 16-bit analog to digital conversion. Each universal input shall have over-voltage protection. Universal inputs shall have the following integrated, software selectable terminations: 1K pullup, 10K pullup, 0-12VDC, 0-20mA. Each universal input shall be software selectable as analog or binary. Manually set, hardware configuration jumpers shall not be necessary.
  - 6. Outputs: The controller shall have on-board universal outputs with a 12-bit digital to analog conversion. Analog outputs shall be capable of sourcing 100 mA per channel and be short circuit protected. Each universal outputs shall be software selectable as analog or binary.
  - 7. Local Status Indicator Lamps: Provide as a minimum, LED indication of CPU status, Ethernet LAN status, MS/TP LAN Status, and Expansion I/O field bus status. For each output module with an optional override card, provide an LED that gives a visual indication of what state it is in (ON/OFF) and markings to indicate the switch setting (H-O-A).
  - 8. Real Time Clock (RTC): Each controller shall have an integrated real-time clock, accurate to 1.5 minutes per month. The system shall automatically correct for daylight savings time and leap years.
  - 9. Power Supply: The power supply for the controller shall be 24 volts AC (-15%, +20%) power. Voltage below the operating range of the system shall be considered an outage.

## 2.07 BACnet ROUTER



- A. General: The BACnet router shall router BACnet traffic between BACnet networks, virtual and/or physical. The router shall be designed for both permanent installations as well as temporary use for BACnet device configuration and BACnet network troubleshooting.
- B. Connections:
  - 1. Power: The router shall be powered wither from 24VAC AC (-15%, +20%) or from USB. The 24VAC connections shall be a removable terminal block accepting 12 to 22 AWG wire.
  - 2. USB: A micro USB connections shall be provided, supporting both temporary device power and device communications.
  - 3. Network Communication Ports: The controller shall have an on-board, 10/100bT Ethernet port and an EIA-485 port. The EIA-485 port shall be optically isolated and have integrated end-of-line (EOL) terminations. The EIA-485 port shall be a removable terminal block accepting 12 to 22 AWG wire.
- C. Configuration: The router shall be fully configured via integrated HTML5 based webpages, without the need for any specialized or PC based software. The router configuration may be exported to/imported from a local file via the configuration webpages.
- D. Communications: The router shall be a native BACnet device, available as EIA-485 (MS/TP) or Ethernet/IP physical connections as required.
  - 1. MSTP: MSTP network baud rates between shall be selectable between 9600 and 115.2k baud. Segmentation shall be supported.
  - 2. Ethernet/IP: The following BACnet For devices enabled with Ethernet/IP connectivity, the user shall be able to select BACnet 8802-3, BACnet IP, BACnet BBMD, or BACnet Foreign Device. Segmentation shall be supported.
- E. Routing: The router shall support: one BACnet MSTP network, one BACnet 8802-3 network, and two BACnet IP networks, the IP networks selected able as IP, foreign devices or BBMD. The BBMD Foreign Devices table shall support up to 128 entries.
- F. Diagnostics
  - 1. Device Status: The router shall report the status of each MSTP device that is detected on the MSTP network. MSTP MAC address status shall be indicated with the following color coded categories: no devices detected (white), offline (grey), router MAC (blue), active device (green), errors or duplicate (red). Metrics shall indicate the total device count online, average token cycle time, and the average token time per device.
  - 2. Token Use: The router shall report state of the MSTP token. The status of the token as it is passed between MSTP devices shall be indicated with the following color-coded categories: passed in less than 100ms (normal, green), passed in more than 100 ms but less than the APDU timeout (slow, yellow), passed in longer than the APDU timeout (red). Poll for Master (PFM) shall be indicated in light blue.
  - 3. Route Status: The router shall report all the known BACnet networks, both directly connected and remote connected. The status of each BACnet network should be identified, indicating the following network states: active, busy, down/gone, or duplicated network, duplicated MSTP MAC, sole MSTP master, BBMD: Unknown, BBMD: Multiple, Foreign Devices NAK.

- G. Time Master: The router shall be a BACnet time sync master, capable of syncing BACnet network time to either local (PC) or a SNTP Time server. Both UTC and local time shall be supported.
- H. Firmware Upgrades: The router firmware shall be upgradeable for updates as future enhancements and expanded functionality. Firmware updates shall be supported via BACnet communications (over-the-network) and through the integrated configuration webpages.

## **2.08 OTHER CONTROL SYSTEM HARDWARE**

- A. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- B. Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- C. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall have indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

## **2.09 BAS SERVER & CATnet BASview CH-2 WEB BROWSER GUI - SYSTEM OVERVIEW**

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet. Server manufactured by CATnet Systems CH-2 BASview.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
  - 1. Trending.
  - 2. Scheduling.
  - 3. Electrical demand limiting.
  - 4. Duty Cycling.
  - 5. Downloading Memory to field devices.
  - 6. Real time 'live' Graphic Programs.

7. Tree Navigation.
8. Parameter change of properties.
9. Set point adjustments.
10. Alarm / event information.
11. Configuration of operators.
12. Execution of global commands.
13. Add, delete, and modify graphics and displayed data.

## **2.10 WEB BROWSER GRAPHICAL USER INTERFACE**

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events. All graphics shall 100% replicate the existing system in functionality, 3-D displays and operation.
- B. 3-D Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Graphics tools used to create Web Browser graphics shall be non-proprietary.
  1. 3-D Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors. Provide a visual display of temperature relative to their respective set points.
  2. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
- C. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Alarm Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
  1. Alarms View: Each Alarm shall display an Alarms Category, date/time of occurrence, current status, alarm report and a link to the associated graphic for the selected system, area or equipment.
  2. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
  3. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Reporting Actions shall be as follows:

- a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
  - b. Email: Email shall be sent via compatible e-mail server. Email messages may be copied to several email accounts.
- D. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
  - 1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane.
  - 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Systems that rely on a gateway/router to run trends are NOT acceptable.
  - 3. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
- E. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications. VRF System control wiring furnished by others.
- B. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by Building Automation Systems, Inc. 858-309-2022.

### **3.02 WIRING**

- A. All low voltage electrical control wiring to the control panels shall be the responsibility of the Control System Contractor. All high voltage (120v or higher) furnished & installed by others.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways were exposed to damage. Plenum rated cabling allowed in concealed, accessible areas.
- C. Campus standard DDC System color coded wiring is required.
- D. Use manufacturer-specified wire for all network connections.

### **3.03 ACCEPTANCE TESTING**

- A. Upon completion of the installation, the Control System Contractor shall load all system

software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

- B. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

### **3.04 OPERATOR TRAINING**

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 8 total hours of training for system orientation, product maintenance and troubleshooting, programming and engineering.

### **3.05 WARRANTY PERIOD SERVICES**

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty. NO SOFTWARE MAINTENANCE FEES OR AGREEMENTS NECESSARY FOR AN INDEFINITE TIME PERIOD. All SNC and BAS Servers are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period.
- E. Service Period: Calls for service by the Owner shall be addressed either remotely or on-site within 24 hours and are not to be considered as part of routine maintenance.

### **3.06 OPERATION & MAINTENANCE MANUALS**

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
  - 1. As-built control drawings for all equipment.
  - 2. As-built Network Communications Diagram.
  - 3. General description and specifications for all components.
  - 4. Completed Controller Checkout/Calibration Sheets.

**END OF SECTION**

**SECTION 23 23 00**  
**REFRIGERANT PIPING**

**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. Refrigerant pipes and fittings.
  - 2. Refrigerants.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
  - 1. Include pressure drop, based on manufacturer's test data, for the following:
    - a. Thermostatic expansion valves.
    - b. Filter dryers.
    - c. Expansion compensation calculations (loops, u-bends or offsets) based on actual installed piping configuration.
- B. 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.
  - 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 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 Qualifications: Qualify procedures and personnel according to 2010 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.

## **PART 2 PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

### **2.02 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver)
- E. 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. Working Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.
  - 6. Aluminum Fittings: ETL Tested and Listed to UL 207.

### **2.03 REFRIGERANTS**

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane (Puron).



## **PART 3 EXECUTION**

### **3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A**

- A. Aboveground, within Building: Type ACR drawn-copper tubing.

### **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. Provide for thermal expansion in refrigerant system by utilizing offsets of expansion loops.
- G. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Provide access doors if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

### 3.03 PIPE 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. 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 BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

### 3.04 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "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 diameters:
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
  - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
  - 8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
  - 9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

### 3.05 FIELD QUALITY CONTROL

- A. Perform the following 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 "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.
- B. Prepare test and inspection reports.

### **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.

### **3.07 ADJUSTING**

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION**

**SECTION 23 31 13**  
**METAL DUCTS**

**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. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and flat-oval ducts and fittings.
  - 3. Sheet metal materials..
  - 4. Sealant and gaskets.
  - 5. Hangers and supports.
  - 6. 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.

**1.03 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
  - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

**1.04 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".

2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of the following products:
1. Liners and adhesives.
  2. Sealants and gaskets.
  3. Seismic-restraint devices.
- 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 licensed structural engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

### **1.05 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.

- b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.
- B. Welding certificates.
  - C. Field quality-control reports.

## 1.06 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/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. ASHRAE/IESNA 90.1 requires leakage testing for representative sections totaling no less than 25 percent of installed duct area for ducts designated to operate at a static-pressure class in excess of 3-inch wg . Consider building a mockup of typical portions of the system that can be tested early in the construction process. This standard, as enforced by some authorities having jurisdiction, requires duct systems with static-pressure classes in excess of 3-inch wg to be identified on Drawings.

## PART 2 PRODUCTS

### 2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing

requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.02 SINGLE-WALL ROUND AND FLAT-OVAL 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. Factory- or shop-fabricated spiral lock seam duct:
    - a. No snap lock
    - b. Factory-fabricated longitudinal seam acceptable for ducts larger than standard factory sizes
  - 2. Manufacturers:
    - a. United Sheet Metal Division, United McGill
    - b. Semco Manufacturing, Inc.
    - c. Or equal
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. 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.
- D. 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.
- E. Fittings:
  - 1. Same material and construction as duct in which installed
  - 2. For ductwork exposed to occupant view, do not use fabricated fittings at taps to terminal units and outlets. Instead use saddle tap cut into continuous spiral duct. Intent is for spiral duct to be continuous for aesthetic reasons. Saddle tap flange width shall be 0.5 inches or less.
- F. 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."



### 2.03 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. General Applications (except as noted below): G60 Galvanized Coating.
  - 2. Plenum Walls and Blank-Offs Where in Contact with Cooling Coil: G90 Galvanized Coating.
  - 3. Exterior Applications: G90 Galvanized Coating.
  - 4. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90
  - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings, and minimum 1 mil thick on opposite surface.
  - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304L or 316L, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. 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.

### 2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 3 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  9. VOC: Maximum 395 g/L.
  10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  12. Service: Indoor or outdoor.
  13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.

5. Use: O.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. 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.

## **2.05 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. 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."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. 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.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## **2.06 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. Hilti Corp.
  2. TOLCO; a brand of NIBCO Inc.
  3. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.

- 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-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle or channel unistrut 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 round and flat-oval 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 as required by NFPA 90A. 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 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval 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.

### **3.03 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 "OSHPD Preapproved Manufacturer's Certification (OPM)."
  - 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 ICC Evaluation Service.

- 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.

### **3.04 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.

### **3.05 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting"

### **3.06 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days advance notice for testing.

- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- D. Contractor shall develop and implement an IAQ Management Plan for the construction and preoccupancy phases of the building as follows:
  - 1. During construction meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, and Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
  - 2. Protect stored materials on-site and installed absorptive materials from moisture damage.
  - 3. If permanently installed air handlers are used during construction, then filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-2012 (with errata, but without addenda). Replace air filtration media immediately prior to occupancy.
- E. Duct system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.07 DUCT CLEANING

- A. Clean **new and existing** duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  6. Provide drainage and cleanup for wash-down procedures.
  7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### **3.08 START UP**

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### **3.09 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel.
- B. Supply Ducts:
1. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- C. Return Ducts:



1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  2. 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 Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- 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. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- 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. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  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 Rectangular: 4.

- d. SMACNA Leakage Class for Round and Flat Oval: 2.
- F. Intermediate Reinforcement:
- 1. Galvanized-Steel Ducts: Galvanized steel.
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
- G. Elbow Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 with single-thickness turning vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and single-thickness turning vanes.
      - 3) Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.5 radius-to-diameter ratio and single-thickness turning vanes.
      - 3) Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and single-thickness turning vanes.
    - c. Mitered Type RE 2 with single-thickness vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 3. 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: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
  - 2) Velocity 1000 to 1500 fpm: 1.5 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, 10 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 12 Inches and Larger in Diameter: Welded.

H. 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. Taps shall be the more stringent of what is shown on the mechanical drawings and the criteria listed below. 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 900 fpm or Lower: 90-degree tap.
  - b. Velocity 901 to 1500 fpm: Conical tap.
  - c. Velocity 1501 fpm or Higher: 45-degree lateral.

**END OF SECTION**



**SECTION 23 33 00**  
**AIR DUCT ACCESSORIES**

**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. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Fire dampers.
  - 4. Flange connectors.
  - 5. Turning vanes.
  - 6. Duct-mounted access doors.
  - 7. Flexible connectors.
  - 8. Flexible ducts
  - 9. Duct accessory hardware.

**1.03 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. Sustainable Design Submittals:
  - 1. Product data showing compliance with ASHRAE 62.1.
- C. 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.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

### **1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in 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. 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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2D finish for concealed ducts and No. 4 finish for exposed ducts.
- 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; compatible materials for aluminum and stainless-steel 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 BACKDRAFT AND PRESSURE RELIEF DAMPERS**

- A. Manufacturers shall be Ruskin, Greenheck or equal.
- B. Frame: 8 inches x minimum 0.125 inch 6063-T5 extruded aluminum channel with front flange and galvanized steel braces at mitered corners.
- C. Blades:
  - 1. Style: 2V.
  - 2. Action: Parallel.
  - 3. Orientation: Horizontal.

4. Material: Minimum 0.070 inch 6063-T5 extruded aluminum.
  5. Width: Maximum 6 inches.
- D. Bearings: Galvanized Steel Ball Axle Bearings.
  - E. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
  - F. Linkage: External heavy duty type with steel clevis arms and plated steel tie bars & pivot pins with nylon pivot bearings.
  - G. Axles: Stainless steel.
  - H. Counterbalances: Adjustable externally mounted counterbalance weights mechanically attached to blade enabling damper to operate over wide range of pressures.
  - I. Finish: Mill aluminum.
  - J. Performance Data:
    1. Temperature Rating: Withstand -20° to 180°F.
    2. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
      - a. Closed Position: Maximum differential pressure of 5 inches w.g..
      - b. Open Position: Maximum air velocity of 3,900 feet per minute.
    3. Pressure Drop: Maximum 0.3 inch w.g. at 10,000 CFM through 36 inch x 36 inch damper.

#### **2.04 MANUAL VOLUME DAMPERS**

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- D. Fabricate single blade dampers for duct sizes to 12 x 48 inch.
- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

#### **2.05 FLANGE CONNECTORS**

- A. Manufacturer shall be Ductmate, CL WARD, or equal.

- 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.

## **2.06 TURNING VANES**

- A. Manufacturer shall be Ductmate, CL WARD, or equal.
- 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.
- 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: Double wall.
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## **2.07 DUCT-MOUNTED ACCESS DOORS**

- A. Manufacturers shall be Ventfrabrics, Ductmate, Pottorf Company or equal.
- B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.
- C. Review locations prior to fabrication.
- D. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- E. Access doors smaller than 12 inches square may be secured with sash locks.
- F. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- G. Access doors with sheet metal screw fasteners are not acceptable.

## **2.08 FLEXIBLE CONNECTORS**

- A. Manufacturer: Ventfrabrics, Duro Dyne or equal.
- 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 3-1/2 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
- G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
  - 1. Minimum Weight: 14 oz./sq. yd.
  - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
  - 3. Service Temperature: Minus 67 to plus 500 deg F
- H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor 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. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.09 FLEXIBLE DUCTS

- A. Manufacturers:
  - 1. Casco,
  - 2. Thermaflex,
  - 3. Or submitted equal approved by the Engineer of Record.
- B. Flexible Ductwork up to 22" ID:
  - 1. UL 181, Class I Air Duct.
  - 2. Minimum positive static pressure class: 6 inches w.c.
  - 3. Minimum negative pressure class: 1 inch w.c.
  - 4. Insulated to a minimum of R-4.2.
  - 5. Product basis of design: Casco Cal-Flex 2PMJ or submitted equal approved by the Engineer of Record.

## 2.10 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 and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install 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. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers and backdraft dampers, and equipment.
  - 6. 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.
  - 7. At each change in direction and at maximum 50-foot (15-m) spacing.

8. Upstream and downstream from turning vanes.
  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 23 05 53 "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 diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with draw bands and adhesive plus sheet metal screws.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### **3.02 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 fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  4. Inspect turning vanes for proper and secure installation.
  5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION**



**SECTION 23 34 23**  
**HVAC FANS**

**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. Utility set fans.
  - 2. Upblast Centrifugal roof ventilators.

**1.03 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. 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.
  - 7. Fan speed controllers.
- C. Shop Drawings:
  - 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. Include diagrams for power, signal, and control wiring.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

### **1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For HVAC fans 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. Belts: One set(s) for each belt-driven unit.

### **1.07 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: HVAC fans shall comply with UL 705. HVAC fans for use for restaurant kitchen exhaust shall also comply with UL 762.

### **1.08 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.
- D. Provide access around equipment as specified on plans and/or according to manufacturer's requirements.

### **1.09 WARRANTY**

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents
- B. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.

## **PART 2 PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Unusual Service Conditions
  - 1. Base fan-performance ratings on the following:
    - a. Ambient Temperature: 70 deg F.
    - b. Altitude: 0 feet above sea level.

- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation and seismic restraints, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Seismic Performance: HVAC power ventilators shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.5.

## 2.01 UTILITY SET FANS

- A. Manufacturers:
  - 1. Greenheck Fan Company.
  - 2. Loren Cook Company.
  - 3. PennBarry
  - 4. Twin City Fans
- B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
  - 1. Housing Discharge Arrangement: Adjustable to eight standard positions.
- C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
  - 1. Blade Materials: Aluminum.
  - 2. Blade Type: Airfoil.
- D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
- E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9.
  - 1. Extend grease fitting to accessible location outside of unit.
- F. Belt Drives:
  - 1. Factory mounted, with final alignment and belt adjustment made after installation
  - 2. Service Factor Based on Fan Motor Size: 1.5.
  - 3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  - 5. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories:
  - 1. Inlet and Outlet: Flanged.
  - 2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
  - 3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.

4. Access Door: Gasketed door in scroll with latch-type handles.
5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
6. Inlet Screens: Removable wire mesh.
7. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
9. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
10. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
11. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

## **2.02 CENTRIFUGAL VENTILATORS - ROOF UPBLAST OR SIDEWALL**

- A. Manufacturers:
  1. Greenheck Fan Company.
  2. Loren Cook Company.
  3. PennBarry
  4. Twin City Fans
- B. Configuration: Centrifugal roof upblast ventilator.
- C. Housing: Removable spun aluminum; round, 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.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined
- E. 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; minimum ABMA9, L(10) of 100,000 hours.
  4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions. Provide fixed pitch for use with motors larger than 5 hp.
  6. Fan and motor isolated from exhaust airstream.
- F. Accessories:
  1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
  2. Insect Screens: Removable, 1/4-inch mesh, aluminum or brass wire.
  3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  4. Mounting Pedestal: Galvanized steel with removable access panel.



- G. Prefabricated 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: Self-flashing without a cant strip.

### **2.03 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "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.

### **2.04 SOURCE QUALITY CONTROL**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.
- E. Operating Limits: Classify according to AMCA 99.
- F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install HVAC fans level and plumb.
- B. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
  - 2. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration Controls for HVAC."
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 07 72 00 "Roof Accessories" for installation of roof curbs.
- D. Install units with clearances for service and maintenance of fans, motors and all other components that may need access
- E. Label units according to requirements specified in Section 23 05 53 "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 23 33 00 "Air Duct Accessories."
- B. Install ducts adjacent to HVAC fans to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### **3.03 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.
- 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, align and adjust belts, and install belt guards.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. 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. Adjust belt tension.
- C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

**END OF SECTION**



**SECTION 23 37 13**  
**DIFFUSERS, REGISTERS, AND GRILLES**

**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. Round ceiling diffusers.
  - 2. Fixed face grilles.
- B. Related Requirements:
  - 1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

**1.03 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
  - 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 and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

**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-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 2. Duct access panels.
- B. Source quality-control reports.

## **PART 2 PRODUCTS**

### **2.01 ROUND CEILING DIFFUSERS**

- A. Manufacturers:
  - 1. Titus TMR .
  - 2. Krueger.
  - 3. Price Industries.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Steel.
- D. Finish: Baked enamel, white
- E. Face Style: Three cone.
- F. Mounting: Duct connection.
- G. Pattern: Fully adjustable.
- H. Accessories:
  - 1. Combination damper and equalizing grid.
  - 2. Sectorizing baffles.

### **2.02 GRILLES**

- A. Manufacturers:
  - 1. Titus 350 RL
  - 2. Krueger.
  - 3. Price Industries.
- B. Fixed Face Grille
  - 1. Material: Steel.
  - 2. Finish: Baked enamel, color selected by Architect.
  - 3. Face Blade Arrangement: Horizontal; spaced 3/4 inch apart.
  - 4. Core Construction: Integral Removable.
  - 5. Frame: 1-1/4 inches wide.
  - 6. Mounting Frame: Filter.
  - 7. Mounting: Countersunk screw.
  - 8. Accessory: Filter.

### **2.03 ACCESSORIES**

### **2.04 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers 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 are 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 level and plumb.
- B. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.03 ADJUSTING**

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**





**SECTION 23 37 23**  
**HVAC GRAVITY VENTILATORS**

**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. Roof hoods.

**1.03 PERFORMANCE REQUIREMENTS**

- A. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

**1.04 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

**1.05 COORDINATION**

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.

- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## **2.02 FABRICATION, GENERAL**

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Provide relief backdraft damper
- D. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- E. Fabricate supports, anchorages, and accessories required for complete assembly.
- F. Perform shop welding by AWS-certified procedures and personnel.

## **2.03 ROOF HOODS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Loren Cook Company.
  - 3. Twin City
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Aluminum sheet, minimum 0.063-inch-thick base and 0.050-inch-thick hood suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with 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 fit roof opening and ventilator base.
  - 1. Configuration: Self-flashing without a cant strip, with a mounting flange.
- E. Insect Screening: Stainless-steel, 18-by-18 mesh, 0.009-inch wire.
- F. Aluminum Sheet Finish:
  - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to

ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
  - a. Color and Gloss: As selected by Architect from manufacturer's full range.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

### **3.02 CONNECTIONS**

- A. Duct installation and connection requirements are specified in Section 23 31 13 "Metal Ducts" Drawings indicate general arrangement of ducts and duct accessories.

### **3.03 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.

**END OF SECTION**



**SECTION 23 74 13**  
**CUSTOM AIR HANDLING 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 central station air handling units.
- B. Related Sections:
  - 1. Section 23 00 00 "General Mechanical Requirements"
  - 2. Section 23 05 13 "Common Motor Requirements"
  - 3. Section 23 31 13 "Metal Ducts"
  - 4. Section 23 33 00 "Air Duct Accessories."
  - 5. Section 23 81 27 "Large Capacity Variable Refrigerant Volume Systems"

**1.03 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 23 00 00 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All exceptions shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Submittals:
  - 1. Manufacturer shall provide the following information with each shop drawing/product data submission:
    - a. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.
    - b. Each component of the unit shall be identified. Mechanical specifications describing construction, components, and options shall be provided for the unit and all accessories. All performance data, including capacities and airside and waterside pressure drops, for components.
    - c. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.
    - d. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.

- e. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.
  - f. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).
  - g. Motor data.
  - h. Sound Test for the AHU in accordance with AMCA Standard 300-96, Reverberant Room Method for sound testing of fans, and where relevant, AHRI Standard 260-01, Sound Ratings of Ducted Air Moving and Conditioning Equipment.
  - i. Airflow measuring device performance ratings in accordance with AMCA 611.
  - j. Static pressure profiles by component section.
  - k. Casing leakage rate at +/- 10" / [12"] w.g., specified in terms of percentage of design airflow.
  - l. Panel deflection data.
  - m. Fan balance test data showing calculations for deflection and critical speed of the shaft.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- 1. Detail equipment assemblies and indicate dimensions, weights, load distribution, 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: Floor 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. Structural supports.
  - 2. Piping roughing-in requirements.
  - 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
  - 4. Access requirements including working clearances for mechanical controls and electrical equipment, tube pull clearances, and service clearances.
- B. Certificates: For certification required in "Quality Assurance" Article.

#### **1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each air handling unit, provide emergency, operation, and maintenance manuals.
- B. Warranty

#### **1.06 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. Comply with NFPA 70.
- D. Unit shall bear an ETL label, conforming to UL Standard 1995. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a ETL representative to verify conformance.
- E. Fans shall be AMCA certified for sound and performance in accordance with AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes and AMCA 300 – Test Code for Sound Rating Air Moving Devices.
- F. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices.
- G. AMCA 500 – Test Methods for Louver, Dampers, and Shutters
- H. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s).
- C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.
- D. Unit shall be shipped in a shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.
- E. Installing contractor shall be responsible for storing AHU in a clean, dry place and. Contractor shall protect units from weather, construction traffic, dust, and debris.
- F. Handle unit and componenets carefully to avoid damage to components, enclosures, and finish Protect, pack, and secure controls devices, electronic equipment, loose-shipped devices, electronic or pneumatic devices.

#### **1.08 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. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.
- B. Warranty shall cover air handling unit and accessories, excluding routine maintenance parts such as filters and belts.

- C. Contractor shall provide a Labor 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Scott Springfield Manufacturing inc.
  - 2. Pre Approved Equal.

**2.02 MANUFACTURED UNIT**

- A. Manufacturer shall provide outdoor, rooftop, integral base frame unit to support and raise all sections of the unit for proper trapping. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in trap

**2.03 UNIT BASE**

- A. Unit base shall be fabricated from ASTM A36 welded structural steel channel or tubular steel. Formed bases are not acceptable. Bases shall be sized as a function of air handling length as follows:

Channel Construction:

Unit Length	Minimum Channel Size	Weight/Foot
Up to 10 feet	4" x 1-5/8"	5.4 lbs/ft
11 to 20 feet	6" x 2"	8.2 lbs/ft
21 to 30 feet	8" x 2-1/4"	11.5 lbs/ft
31 to 40 feet	10" x 2-3/5"	15.3 lbs/ft
41 to 50 feet	12" x 3"	20.7 lbs/ft

Tubular Steel Construction:

Unit Length x Width	Minimum Tube Size
Up to 16 feet x 97" wide	4" x 2"
Up to 20 feet x 139" wide	5" x 2"
Up 25 feet x 181" Wide	6" x 2"
Up to 25 feet x 300" wide	8" x 2"

- B. Frame members shall be sized to limit deflection to L/200, minimizing deflection during rigging and installation. Intermediate tubular steel or C-Channel cross members are fully welded and located at lifting points and as needed to support internal components such as coils, fans, etc. Removable or welded lifting lugs shall be added to the perimeter channel along the longest length of the unit.
- C. Structural floor panels shall be 14-gauge or thicker bright galvanized steel with deep flanges and a maximum panel width of 24" for exceptional rigidity. Flooring shall be welded or screwed to unit frame. All panels shall be fully caulked with a high performance polymer sealant. Sealant



shall be low VOC and be free of silicone and isocyanates. Section splits shall be supplied with an upturned bolted flange and u-clip for field connections.

- D. All access section floors shall be covered with 0.125" thick, #3003 aluminum tread plate sheets.
- E. The entire floor and frame shall be foamed with a 2-part polyurethane foam. Minimum foam thickness shall be 2" underneath the base surface and ½" on flanges and angles. Provide 20 gauge galvanized steel liner.

#### 2.04 UNIT CASING

- A. 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 or thicker galvanized steel. The panels shall be caulked and attached to each other, to the roof, and to the floor. 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. The casing structure shall incorporate insulating thermal breaks as required so that, when fully assembled, there exists no path of continuous unbroken metal to metal conduction from inner to outer surfaces.
- B. Minimum sound transmission loss (STL) through unit panels shall be as follows:

OCTAVE BAND CENTER FREQUENCY

125	250	500	1K	2K	4K
25	29	36	42	47	48

- C. Outdoor units shall have roofs with a minimum of ¼" per foot slope to insure no standing water.
- D. Insulation and Interior Liner: Insulation shall be 2" thick, 3 lbs per cubic foot density, neoprene coated fiberglass to cover all walls and ceilings. This insulation shall meet NFPA-90A smoke and flame spread requirements. All floors shall be insulated from below using minimum 1" thick foam to insure 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 bright 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.
- E. Paint Finish: After final assembly the unit exterior shall be coated with an industrial grade high solids polyurethane paint. In addition, all fan bases, springs and structural steel supports shall be coated with the same finish. The paint system shall meet AISTM B Salt spray test for 2000 hours in a 5% solution. Paint shall be applied in an environmentally sealed paint chamber specifically designed for paint application. Manufacturers without paint booth facilities shall use pre-painted 16 gage steel that meets ASTM B117 2000 hr salt spray testing.

#### 2.05 ACCESS DOORS

- A. All access doors shall be hinged, double wall, and insulated with the same material as the unit casing. Person-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 @ 6" static pressure.

- B. Door hinges and latches shall be easily adjustable, without the use of shims or special tools, to allow for a tight seal between the door and the doorframe as the gasketing material compresses over time.
- C. All doors shall open against pressure to ensure an airtight seal and to prevent a safety hazard. The door hinge design shall allow for field reversing of door swing and doors shall be easily removable. Provide door detail drawing with submittal package.
- D. Doors entering into 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. All doors must swing against the air pressure (i.e., positive pressure plenum doors must swing in).
- E. All access doors shall include an 8" x 12" wire reinforced UV protected glass view window.
- F. All access doors shall include instrument test holes to enable measurement of pressure drop across unit components. Test ports shall have a removable cover that completely seals the door penetration when testing and balancing is not being conducted.
- G. Door latches and handles shall be constructed of corrosion-resistant material. Corrosion-resistant and UV-resistant material shall be used for outdoor applications.

## 2.06 FANS

- A. Fans provided with low temperature brushless DC electronically commutated motor (ECM) with external rotor and integrated maintenance free electronic circuitry and electronics with integral array controller shall be acceptable.
- B. Each fan shall be sized to perform as indicated on the equipment schedule. The wheel diameter shall not be less than that shown on the equipment schedule. The fan shall be constructed to AMCA Standards for the Class Rating as indicated on the Equipment Schedule.
- C. 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" or as indicated on schedules. The spring isolators shall be mounted to structural steel members. All isolators shall be rated for Seismic Zone 4 requirements. The spring isolators shall be mounted on a waffle pad for vibration isolation.
- D. Balancing: The fan shaft shall be sized not to exceed 75% of the first critical speed for maximum RPM of Class specified. The critical speed will refer to the top of the speed range of the fans' AMCA class. The lateral static deflection shall not exceed 0.003" per foot of the length of the shaft. Fans shall be balanced to ISO standard G6.3. A copy of the balance test data for this project showing calculations for deflection and critical speed of the shaft and wheel assembly shall be submitted to the engineer and a copy forwarded to the Owner.
- E. Plenum fan assembly must have an enclosed safety screen built per OSHA Standards. Fans shall have OSHA approve inlet screens.
- F. Hoist Rail: Provide I beam hoist rail above fan section access doors to remove motors 10 hp and above. An optional extendable arm to be provided to transport the motor to the unit exterior.
- G. Provide factory mounted gravity backdraft dampers for all fans.
- H. Fan bearings are to have a minimum average life (L50) of 200,000 hours per ANSI/ABMA 9 or ANSI/ABMA 11 for ball bearings and roller bearings, respectively.
- I. All fan bearings shall have grease fittings extended to an accessible location.

J. Fan Airflow Measurement:

1. Supply air and return air shall be measured by a Flow Track sensor (piezo ring) and a Veltron 2500+ Air Flow Transmitter or Engineer approved equal. The flow measuring station shall not obstruct the inlet of the fan and shall have no effect on fan performance (flow or static) or sound power levels.
2. All transmitters shall be mounted outside the unit for access or shipped loose for field mounting by controls contractor. Interface to BMS is by others.

## 2.07 MOTORS AND DRIVES

- A. All motors and drives shall be factory-installed and run tested.
- B. Refer to Specification Section 23 05 13 COMMON MOTOR REQUIREMENTS for additional requirements.
- C. All motors and drives shall be factory-installed and run tested. Motors shall be premium efficiency, TEFC, NEMA frame, ball bearing type motors.

## 2.08 COILS

- A. See 238127 Large Capacity Variable Refrigerant Volume Systems.
- B. Coils shall be fully enclosed within the casing and cooling coil drain pans shall extend fully under the coil header and return bends. Coils shall be mounted on angle racks such that the coils may be individually removed. Cooling coil racks shall be 304 stainless steel and heating coil racks shall be galvanized steel
- C. Intermediate condensate pans are to be furnished on multiple coil units and single coils greater than 48" high. The pans shall be 16Ga. 316 stainless steel and drain to the main drain pan through copper downspouts.
- D. All refrigerant coils shall be rated in accordance with ARI Standard 410. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all coils supplied for the air handlers.
- E. Coil connections shall be extended through the unit casing. Provide grommet seals where the coils penetrate the casing and completely seal off the internal side of the coil penetration.
- F. Provide a continuously welded 16 gauge 304 stainless steel drain pan double sloped for positive drainage under all cooling coils. Intermediate drain pans for stacked coil configurations are to be the same material as the primary drain pan interconnected with 1" copper drain line
- G. Tube Material - ½" OD tube diameter with 0.016" copper tube wall.
- H. Fin Material – 0.0075" aluminum with maximum 10 FPI
- I. Casing Material – galvanized casing.
- J. Coil Connection - copper

## 2.09 PRIMARY DRAIN PANS

- A. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in three planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.

- B. Cooling coil section shall be provided with a 16 gauge, 316 stainless steel drain pan. The drain pan shall be insulated beneath the surface with 2.0", 2-part polyurethane insulation to prevent condensation under the drain pan.
- C. Coil support members inside the drain pan shall be 10 gauge, #316 stainless steel.
- D. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.
- E. All drain pan threaded connections shall be visible external to the unit and shall discharge at the side of the unit.
- F. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.
- G. Provide left or right hand coil connections as shown and coordinated with the bid documents and submitted for review.

## **2.10 FILTERS**

- A. 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. Internal blank-offs shall be provided by the air handling unit manufacturer as required to prevent air bypass around the filters.
- B. All air filters shall be State Fire Marshal approved and listed type. Preformed filters having combustible framing shall be tested as a complete assembly. Air filters in all occupancies shall be Class 2 or better, as shown in the State Fire Marshal listing. Air filters shall be accessible for cleaning or replacement.
- C. Filters shall be of the quantities and sizes as indicated on the drawings.
- D. Provide one set of additional startup pre-filters.
- E. Provide factory installed Setra 267 digital filter gauge with LCD display or Engineer approved equal at each filter bank.
  - 1. Gauge shall be complete with static pressure tips, hardware and fittings.
  - 2. Enclose the gauge in a protective sheet metal box with a hinged inspection door. Paint to match unit.
  - 3. Provide IP65/NEMA 4 rated enclosure. All transmitters shall be mounted outside the unit for access.

## **2.11 ECONOMIZER, MINIMUM OSA, RETURN and RELIEF AIR DAMPER SECTION**

- A. 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. Furnish full height 24" wide access doors for damper and linkage service.
- B. 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/ft<sup>2</sup> at 5.0" of static pressure. Leakage testing shall be in accordance with AMCA standard 500 figure 5.5. Test results must be from independent testing laboratory.

- C. Provide louvers for outside air and exhaust air for units located outdoors. OSA Louvers shall be sized for a maximum face velocity of 750 fpm and exhaust air louvers shall be sized for a maximum face velocity of 800 fpm based on gross louver area. Louvers shall have zero water penetration at 600-ft/min air velocity. Maximum louver pressure drop shall be 0.03" in w. g. at 700 ft/min. Provide test results from independent testing laboratory. Test must be conducted in accordance to AMCA Standard 500 figure 5.5. Louver water carry over must be less than 0.01 oz/ft<sup>2</sup> at 1100 ft/min of free louver area. Test must be conducted by independent testing laboratory per AMCA 500-89 figure 5.6. Hoods in lieu of louvers are not acceptable.
- D. Damper shall be heavy duty type.

## **2.12 OUTSIDE AIR (OSA) DAMPER AND AIR FLOW MONITORING SECTION**

- A. The OSA dampers shall have individual EBTRON, Inc "Gold Series" Model GTC116-PC airflow measuring devices or equal.
- B. Each airflow-temperature measuring device 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 measurement location.
- C. 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.
- D. Each sensor node shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
- E. 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.
- F. 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.
- G. Each sensing node shall be individually wind tunnel calibrated at 16 points to NIST traceable airflow standards. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range of not less than 0 to 5,000 fpm (25.4 m/s).
- H. 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.
- I. 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. All transmitters shall have integral self-diagnostics.
- J. 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.
- K. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable.

- L. Devices with RJ-45 connections exposed to the environment or having electronic circuitry mounted in or at the sensor node are not acceptable.
- M. Pitot tubes and arrays are not acceptable.
- N. Vortex shedding devices are not acceptable.
- O. The transmitter shall be mounted outside the unit for access.

### **2.13 UNIT MOUNTED CONTROLS**

- A. All controls shall be field installed by the installing temperature controls contractor and coordinated with the new building automation system. These controls shall include all damper actuators, temperature sensors, pressure sensors, air flow measuring sensors, filter switches, smoke and fire detectors as indicated on the control drawings.
- B. Electric and electronic controls shall be wired to a terminal block in a sheet metal enclosure located at a common location mounted on the air handling unit. All pressure sensing controls shall be piped to a common point on the unit with 1/4" compression fittings.
- C. Wiring for chilled water and hot water control valves shall be field supplied by the installing contractor. Control valve wiring shall be extended to an external junction box located near the coil connections with the final wiring connection done by the temperature controls contractor. All control valves and piping specialties shall be provided by the temperature controls contractor and/or piping contractor.
- D. Unit shall include factory installed conduit between sections and split for controls ready construction. If the unit requires splitting; junction boxes shall be furnished on each section to allow the control contractor to make final connections in the field. Wiring shall be clearly labeled to allow ease in final interconnections.
- E. All controls shall be supplied and installed by the Division 230900 temperature controls contractor. All wiring shall be performed in a U.L. 508 listed shop.
- F. Electrical contractor shall bring separate 120/1/60 power for controls.

### **2.14 ELECTRICAL REQUIREMENTS**

- A. All wiring shall be performed in a UL 508 listed shop. Provide single source power panels (SSPP's) that are constructed according to CEC regulations and carry a U.L.508 listing and label. The panel shall include a non-fused main disconnect switch covering all fans in each unit, 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.
- B. 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.
- C. The main control panel shall have access door(s) for direct access to the controls. The panel shall be NEMA type 3R (rainproof) and shall contain a single externally operated, non-fused disconnect, suitable for copper wire up to and including 3" conduit. The electrical contractor shall bring separate 460/3/60 power to the single source power panel.
- D. All wiring shall be run in EMT conduit (or flexible when connecting to a motor). Raceways are not acceptable.

- E. 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 at each fan compartment. The electrical contractor shall bring separate 120/1/60 power to this circuit connected at the supply fan GFI outlet.

## **2.15 ULTRAVIOLET (UV) GERMICIDAL LAMPS**

- A. The air handling unit manufacturer shall furnish and install, including interconnecting wiring and safety interlocks, a germicidal UVC irradiation system for each air handler. A heavy-duty UVC germicidal irradiation system using short wave UVC germicidal lamps shall be furnished with each air handler.
- B. Intensity: The minimal UV energy striking a targeted surface shall be sufficient to destroy a monolayer of common mold and fungi within six hours.
- C. Lamps and fixtures are to be installed in sufficient quantity and in such a manner to ensure equal distribution of UV energy across the cooling face and drain pans.
- D. Lamps: Each lamp shall contain no more than 8 milligrams of mercury consistent with current environmental practices and shall be capable of producing its specified output in temperatures of 55 - 135° and airflow velocities up to 1000 fpm. Useful lamp life shall be 9,000 hours with no more than 20% output loss at the end of one year, continuous use. Lamps shall be constructed of UV proof metal bases and shall not product ozone or other secondary contamination.
- E. Fixtures: Each fixture shall be constructed of stainless steel. Galvanized steel or aluminum is not acceptable. All integral parts of the fixture shall be self-contained. Fixtures constructed to UL drip proof design and equipped with safety approved fixture-to-fixture plugs to facilitate UL approved multiple fixture and row coupling to A/C power. The UV assembly shall include mechanical interlocks to prevent energizing unless the system is properly installed.
- F. Power Supplies: The power supply shall be electronic, high-efficiency type capable of producing the required coverage at no more than 80 watts of power consumption for each four square feet of cross sectional plenum area. Power supply shall be 120 VAC, 60 Hz. Power supply shall be matched to the lamp and designed to maximize photon production, radiance and reliability. Electronic power supply shall be UL listed for application in airstreams between 55 and 135°.
- G. Portal: The UV lamp plenum area shall be equipped with a portal for viewing the lamp assembly. Portal shall be constructed to allow viewing without the possibility of exceeding the Minimal Erythermal Dose.
- H. Testing and Safety Listing: UV fixtures shall have been tested and listed as UL/C-UL under Category Code ABQK (accessories, air duct mounted), UL Standards 153, 1598 and 1995 respectively, no exceptions. Manufacturer of UVC components shall be ISO 9001 certified.
- I. Installation by Air Unit Manufacturer: Air handling unit factory authorized and trained service technicians shall install the tubes in the air-handling units after the units have been installed. UV light manufacturer is to certify installation has been such that UV reflective and shadowed energy losses are the lowest possible. Cumulative sum length of UV fixtures end-to-end shall equal the coil width ± 3 inches. System shall be installed a minimum of 8 inches and maximum of 20 inches from coil surface (based on manufacturer's calculations and recommendations.) One row of lamps shall serve not more than 48 inches of coil height. Installation shall be installed on tracks allowing the UV fixture to slide into place. Tracks shall be designed in such a manner the UV fixture can be easily removed and maintained or replaced. Multiple UV

assemblies shall connect via interlock. Fixture rows shall be terminated (for safety) to factory supplied hard-wired module. Light rows shall be mounted so UVC covers the entire coil face and drain pan surfaces as well as line-of-sight airstream. Air unit manufacturer installation shall include all mechanical interlock and wiring to assure UV light assembly is not energized when any access door is opened. For future reference, the air unit manufacturer shall include detailed and certified drawings locating (placing) the fixtures. Drawings shall also be included in all operation and maintenance manuals.

## **2.16 UNIT SOUND POWER LEVELS**

- A. Provide sound power level data for the unit that will be supplied.

## **2.17 ACCESSORIES**

- A. Contractor shall provide roof curb.
- B. Roof curb shall be constructed of 12 gauge galvanized steel and manufactured by M.W. Sausse Model RMLS non-isolated unit or equal.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances, and other conditions affecting performance of equipment.
- B. Verify that roof is ready to receive Work and opening dimensions are as illustrated by the manufacturer.
- C. Verify that proper power supply is available.
- D. Verify that the required mechanical services are in place.

### **3.02 INSTALLATION**

- A. Install air handling units and accessories plumb and level in accordance with manufacturer's instructions.
- B. Contractor shall install final filters after construction is complete.
- C. Contractor shall replace pre-filter after construction is complete.
- D. Mechanical contractor shall coordinate with Electrical contractor for:
  - 1. Separate 460v/3ph/60Hz power to the single source power panel.
  - 2. Separate 120v/1ph/60Hz power to the externally mounted light switch and convenience outlet.
  - 3. Separate 120v/1ph/60Hz power to the control panel.

### **3.03 UNIT SHUTDOWN**

- A. Contractor shall provide duct smoke detector in main supply air duct from air handling unit or air moving equipment with supply air in excess of 2,000 CFM. Smoke detector shall shut down the air handling unit or air moving equipment when smoke is detected. Connect smoke detector to the building fire alarm system.



### **3.04 CONNECTIONS**

- A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect condensate drain pans using pipe sizes indicated on drawings, Type L 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. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping."
- E. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 23 31 13 "Metal Ducts" and Section 23 33 00 "Air Duct Accessories."
- F. Connect duct to air-handling units with flexible connections. Comply with requirements of Division 23 Section "Air Duct Accessories."

### **3.05 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. Tests and Inspections:
- C. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
- D. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- E. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.06 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service. Do not operate unit until all manufacturer-recommended pre-startup checks have been completed and fan has been test run under observation.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Verify that shipping, blocking, and bracing are removed.
- D. 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.
- E. Verify that safeties and interlocks, including high and low pressure switches and freeze protection sensors, have been installed and are operational.
- F. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards when belts are used.
- G. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
- H. Verify that zone dampers fully open and close for each zone.

- I. Verify that outdoor and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
- J. Verify that ducts are clean.
- K. Comb coil fins for parallel orientation.
- L. Install new, clean filters.
- M. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- N. Engage a factory-authorized manufacturer's service representative to performance factory certified VFD start-up. Starting procedures for air-handling units include the following:
  - O. Energize motor; verify proper operation and rotation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
  - P. Measure and record motor electrical values for voltage and amperage.
  - Q. 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 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### **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.
- B. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### **3.09 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

**END OF SECTION**

**SECTION 23 81 27**  
**LARGE CAPACITY VARIABLE REFRIGERANT VOLUME SYSTEMS**

**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. Large Capacity VRF Heat Pump and Heat Recovery Systems and accessories
  - 2. Related Sections:
    - a. Section 23 00 00 "General Mechanical Requirements"
    - b. Section 23 31 13 "Metal Ducts"
    - c. Section 23 33 00 "Air Duct Accessories"
    - d. Section 23 74 13 "Custom Air Handling Units"

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, static pressure, sound power, and furnished specialties and accessories.
  - 2. Include data on electrical requirements and connections points. Included recommended wire and fuse sizes or MCA, safety and start-up instructions.
  - 3. Include overall dimensions as well as installation, operation and service clearances.
  - 4. Indicate unit shipping, installation and operating weights.
- B. Shop Drawings:
  - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include refrigerant piping layout
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Any deviation from specification or drawings shall be clearly identified in the submittals.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Certificates: For fan coil units, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1. Field quality-control reports.
  2. Sample Warranty: For special warranty.
- C. CLOSEOUT SUBMITTALS
1. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals
  2. In addition to items specified in Section 01 78 00 "Operation and Maintenance Data," include the following
    - a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- D. MAINTENANCE MATERIAL SUBMITTALS
1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - a. VRF Air Handling Units: Furnish 1 spare filters for each filter installed .
- E. QUALITY ASSURANCE
1. Comply with NFPA 70.
  2. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
  3. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
  4. All wiring shall be in accordance with the National Electric Code (NEC).
  5. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
  6. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.
  7. The condensing unit will be factory charged with R-410A.
- F. WARRANTY
1. Limited Warranty Period
    - a. STANDARD ONE-YEAR PARTS WARRANTY FOR A QUALIFIED SYSTEM - The Part(s) of a qualified System, including the compressor, are warranted for a period (the "Standard Parts Warranty Period") ending on the earlier to occur of one (1) year after the date of original installation, or eighteen (18) months from the date of manufacture.
    - b. ADDITIONAL SIX (6) YEAR COMPRESSOR PART WARRANTY - The Compressor is warranted for an additional six (6) year period after the end of the applicable Standard Part Warranty Period (the "Compressor Warranty Period").
    - c. Extended Warranty
  2. The Standard Warranty Period and the Compressor Warranty Period are extended to a total of ten (10) years (the "Extended Warranty Period") for qualified Systems that have been (a) commissioned by a party that has completed the current Training Requirements, (b) such commissioning is pursuant to LG's current published instructions, and (c) the System commissioning results and supporting documents are entered correctly into LG's online commissioning system. Commissioning of a System requires one (1) hour of LG

Monitoring View (LGMV) data. Commissioning results must be entered into LG's online commissioning system within sixty (60) days of the System startup

## **PART 2 PRODUCTS**

### **2.01 APPROVED MANUFACTURERS**

- A. LG Multi V™ 5 Heat Recovery and Heat Pump System
- B. Product Design
  - 1. LG Multi V 5 heating and cooling system shall be an air cooled system allowing user to configure in the field a heat pump or a heat recovery system consisting of one to three outdoor unit modules, conjoined to make a 6-42 ton single refrigerant circuit.
  - 2. Heat recovery systems, employing three pipes, shall be connected to Heat recovery (heat recovery) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements.
  - 3. Heat pump systems shall require two pipes, simultaneous heating and cooling shall not be supported. The heat recovery system shall consist of three pipes, liquid, suction and hot gas pipes. Heat recovery systems operating at 0°F that cannot deliver single phase superheated refrigerant vapor at a minimum of 162°F while operating in the heating mode shall not be acceptable.
    - a. All three-phase VRF heat pump and heat recovery outdoor units shall be from the same product development generation. Mixing of outdoor units from different development generations is not acceptable.
- C. Operating Conditions
  - 1. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions, operation outside of these conditions are possible and may involve non-continuous operations.
    - a. Operating Ambient Air Conditions:
      - 1) Cooling: 5°F DB to 122°F DB <With optional low ambient kit from -9.9°F DB to 122°F DB>
      - 2) Heating: -22°F WB to 61°F WB
      - 3) Cooling Based (ODU reversing valve in cooling position) Synchronous: 14°F DB to 81°F DB (Heat Recovery Operation Only)
      - 4) Heating Based (ODU reversing valve in heating position) Synchronous: 14°F WB to 61°F WB (Heat Recovery Operation Only)
  - 2. Electrical
  - 3. All air source heat pump and heat recovery frame(s) shall be designed and electrically protected to maintain stable continuous compressor operation when provided with 460/60/3 or 208-230/60/3 power with the following specifications:
    - a. 460/60/3 - Voltage tolerance 414V – 528V
    - b. 208-230/60/3 - Voltage fluctuation of ± 10
    - c. Voltage imbalance of up to two percent;
    - d. Power surge of up to 5kA RMS Symmetrical.
  - 4. General Features
    - a. The air-conditioning system shall use R410A refrigerant.

- b. Each system shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
  - c. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
  - d. System shall have following frame configurations vs. capacity.
    - 1) 6 to 20 ton units shall be a single frame only.
    - 2) 22 to 34 ton units shall be dual-frame only.
    - 3) 36 to 42 ton heat recovery units shall be triple frame only
  - e. System shall employ self-diagnostics function to identify any malfunctions and provide type and location of malfunctions via fault alarms.
- D. Field Provided Refrigerant Piping:
- 1. See section 23 23 00 refrigerant piping for supplemental requirements
  - 2. The refrigerant piping system shall be constructed using field provided ACR copper rated for the use with refrigerant R410A, de-hydrated pipe field engineered and assembled with manufacturer supplied Heat recovery unit(s) and Y- branches, as may be required, connected to multiple (ducted, non-ducted or mixed combination) indoor units to effectively and efficiently control the heat pump operation or simultaneous heating and cooling operation of the heat recovery VRF system. Other pipe materials, if used, shall perform, at a minimum, as well as that specified above, shall not have any adverse reactions, for example galvanic corrosion or branch to branch differential pressure drop, with any other components or materials also in use in the system and shall be installed per manufacturer's instructions.
  - 3. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter-driven compressor(s), controls, temperature sensor, humidity sensor, contacts, relay(s), fans, power and communications wiring as necessary to perform both Heat Pump and Heat Recovery operations.
  - 4. Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:
    - a. Refrigerant strainer(s)
    - b. Check valve(s)
    - c. Inverter driven, medium pressure vapor injection, high-pressure shell compressors
    - d. Liquid refrigerant cooled inverter PCB
    - e. Oil separator(s)
    - f. Accumulator /controlled volume receiver(s)
    - g. 4-way reversing valve(s)
    - h. Vapor injection valve(s)
    - i. Variable path heat exchanger control valve(s)
    - j. Oil balancing control
    - k. Oil Level sensor(s)
    - l. Electronic expansion valve(s)
    - m. Sub-cooler (s)
    - n. Vapor Injection Valve(s)
    - o. High and low side Schrader valve service ports with caps

- p. Service valves
- q. Field Insulation:
  - 1) All refrigerant pipe, y-branches, elbows, and valves shall be individually insulated with no air gaps. Insulation heat transfer resistance shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be installed in a compressed state at any point in the system.
  - 2) All joints shall be glued and sealed per insulation manufactures instructions to make a vapor-tight assembly.
- r. Microprocessor:
  - 1) Factory-installed microprocessor controls in the outdoor unit(s), heat recovery unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and heat recovery unit(s) and indoor unit(s) via RS485 (shielded twisted wire pair) network. Control devices shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties as required by this specification. The addition of a separate building control system shall not be required. Other control devices and sequences shall be as specified in other sections of this project specification.
  - 2) Inverter PCB Cooling:
    - a) Cooling of the inverter PCB shall be conducted by way of high pressure, sub-cooled liquid refrigerant via heat exchanger attached to the inverter PCB. The full capacity flow of refrigerant shall pass through the heat exchangers to maximize the cooling effect of the PCBs and to aid in the evaporation process and capacity of the outdoor coil during the heating mode. The recovered heat of the PCBs must be used to enhance the overall heating process, other uses or dissipation of heat to ambient shall not be permitted.
- s. Compressor Control:
  - 1) Fuzzy control logic shall establish and maintain target evaporating temperature ( $T_e$ ) in cooling mode and condensing temperature ( $T_c$ ) in heating mode by Fuzzy control logic to ensure the stable system performance.
  - 2) Initial Test Run (ITR) (Heating or Cooling) / Fault Detection Diagnosis (FDD) Code:
  - 3) This control mode shall monitor and display positive or negative results of system initial startup and commissioning. Heating or Cooling ITR mode will be automatically selected. It shall monitor and provide performance metrics for the following, but not be limited to, refrigerant charge validation, auto-charge operation verification, refrigerant cycle stability, connection ratios, indoor unit status, error status, and the number of indoor units connected. This commissioning specific control mode shall not replace the system error monitoring control system during normal operation.

- t. BMS Integration:
  - 1) The VRF system shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.
- u. Wi-Fi Communication:
  - 1) The outdoor unit microprocessor shall be capable of being monitored via an optional Wi-Fi wireless communications dongle or embedded Wi-Fi transmitter. Wi-Fi shall allow service or maintenance personal access to the complete operating system, via LGMV mobile, without the need of tools other than smartphone or tablet. Active live system review, collection of all system data for a field determined duration presented in a .csv file format or collection of all operating conditions, including all indoor units, valves, sensors, compressor speeds, refrigerant pressures, etc., by snapshot of conditions and placing that snapshot into a powerpoint slide to be reviewed at another time. Systems that require computers, hard-wire only connection, or other devices to collect, review, or record operating conditions shall not be allowed.
  - 2) Indoor Unit Connectivity:
  - 3) The system shall be designed to accept connection up to <64> indoor units of various configuration and capacity, depending on the capacity of the system.
- v. Power and Communication Interruption:
  - 1) The system shall be capable of performing continuous operation when an individual or several indoor units are being serviced; communication wire cut or power to indoor unit is disconnected from power for a minimum of a 24 hour period. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable.
    - A. Connection Ratios:
    - B. The maximum allowable system combination ratio for all VRF systems shall be 130% and the minimum combination ratio shall be 50%.
- w. Comfort Cooling Mode:
  - 1) Comfort cooling shall be initiated via a field setting at the outdoor unit during commissioning or anytime thereafter. Comfort cooling shall allow user to select all or some of the indoor units of a system to automatically modify each of the indoor unit's superheat target set point based on the impending total cooling load of on the indoor unit, the rate of change of the zone temperature relative to set point and optionally, if specified, the rate of change of the zone humidity level.
  - 2) The outdoor unit shall be provided with a factory installed fusible plug or rupture disc. The fusible plug connection shall be threaded for easy connection with a field provided vent pipe to safely discharge the system's refrigerant charge away from the outdoor unit if a building fire causes an



extreme pressure condition in the outdoor unit refrigerant circuit employ for safety a threaded fusible plug.

E. Refrigerant Flow Control

1. An active refrigerant -in-circulation control system consisting of a refrigerant storage container, interconnecting refrigerant piping control valves, pressure transducers, microprocessor control, and software to continuously monitor necessary refrigeration cycle operating parameters to maintain stable cycle operation between minus (-)22°F and 122°F ambient conditions. The refrigerant system operating conditions shall be checked by the algorithm at three minute intervals and if needed automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit.
2. The algorithm shall adjust refrigerant charge automatically:
  - a. As the outdoor air temperature changes;
  - b. System mode of operation changes;
  - c. The path of refrigerant flow through the outdoor coil is modified;
  - d. The system's target suction and head pressure control values are adjusted.
  - e. Subcooler:
    - 1) The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a shell and tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required. Brazed plate heat exchangers shall not be allowed for this function.
  - f. Advanced Smart Load Control:
    - 1) The air source unit shall be provided with Smart Load Control (SLC) enhanced energy-saving algorithm that reduces compressor lift during off-peak operation to further reduce system energy consumption when weather and load conditions permit
    - 2) The SLC algorithm shall be monitoring in real-time, the rate of change of the outdoor ambient air temperature, either the outdoor ambient air relative humidity or the indoor air relative humidity [field selectable], and the rate of change of the building load.
    - 3) The SLC algorithm shall foresee pending changes in the building load, outdoor temperature and humidity (or indoor humidity) and proactively reset head and/or suction pressure targets in anticipation of the reduction/increase in building load.
    - 4) The SLC algorithm shall provide no fewer than three (3) field selection options to maximize the control of the VRF system operation during morning warm-up or cool-down following night-setback reset. The selection shall be set by the commissioning agent (or at any other time thereafter). Selectable algorithm choices include:
      - a) Maximize energy savings
      - b) Balance the rate of temperature change with energy consumed.
      - c) Quickly cool/heat the building.

## 2.02 Refrigerant Volume Management

- A. Active Refrigerant Charge
- B. The VRF system shall be able to operate at any and all published conditions year-round in cooling or heating mode without the need of adding or removing refrigerant from the system.
- C. The air source unit shall be provided with an isolated vessel, interconnecting piping, valves and sensors to store refrigerant and actively pass refrigerant to (or from) the refrigerant circuit in real-time as necessary to maintain stable refrigeration cycle operation.
- D. The air source unit microprocessor shall be provided with an algorithm that monitors the VRF system head pressure, suction pressure, subcooling, superheat, compressor speed, high and low side temperatures and the load on the system at three-minute intervals and if needed, automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit.
- E. Manual Seasonal Refrigerant Charge Adjustments
  - 1. *(Applicable for VRF systems without Active Refrigerant Charge)*
  - 2. Alternates: Systems that CANNOT passively and automatically modify the active refrigerant charge using the method(s) stated in the section *Active Refrigerant Charge* shall clearly state so in bold capital letters in the proposal that this feature is not included.
  - 3. VRF systems that cannot perform active refrigerant control may submit their proposal as an Alternate. However, all Alternate proposals must BUT include as part of the equipment price the cost of to provide bi-annual refrigerant charging services for 15 years. Service shall be performed by the factory authorized agent only. Service shall include refrigerant, parts, labor, truck and/or trip charges, and any miscellaneous fees necessary to analyze the current state of the system and perform the refrigerant charge adjustment. Service must occur one month before the winter season and one month before the summer season.
  - 4. If the VRF system requires a charge adjustment more frequently to maintain stable operation, the VRF manufacturer shall provide additional services at no additional charge.
  - 5. The 15 year period shall begin on the date the equipment is commissioned or the date the building occupancy permit was issued for the area(s) served by the system – whichever date is later.
  - 6. This service shall be underwritten, warranted, and administered by the VRF equipment manufacturer – not the local distributor or applied representative
  - 7. The selected service provider shall be mutually agreeable between the building owner (or owners agent) and must be licensed, insured, and trained to work on the VRF system. No third party service (subcontracted service) providers will be acceptable.
  - 8. If the service provider is not an employee of the VRF manufacturer, the service provider shall be reimbursed for services rendered directly from the manufacturer. Labor rate for services shall be paid at the prevailing union wage rate in place at the time of service.
- F. VRF Systems with Onboard Alternate Operating Mode Selection Capability
  - 1. All VRF systems equipped with field selectable Alternate Operating Modes via DIP Switch or other means, for example, but not limited to, High Heat, High Ambient Cooling, High Sensible, or Enhanced Efficiency selections. Performance using the proposed field selected Alternate Operating Mode shall be tested using AHRI Standard 1230 and published in the AHRI Directory.

2. Acceptable Alternate Operating Modes must ship with all models of the VRF product offering and must be factory embedded. Custom factory or field modifications to factory-provided algorithms created to meet scheduled requirements are not acceptable.
  3. Provide a copy of the instructions required to set the Alternate Operation Mode with the initial submittal.
  4. For systems that provide field selectable Alternate Operating Modes, ALL technical data provided in the submittal data sheets showing product rated condition performance data, must also provide separate data sheets that show product performance data at each of the field selectable Alternate Operating Modes available. Capacity, power input, and acoustic performance data for each mode offered shall be reported separately. Mixing of ODU, IDU, or VRF system performance capability operating in one mode with for example the power consumption, sound power rating, or electrical requirements of the same system operating in another mode is not acceptable.
- G. Field Supplied Refrigerant Piping Design Parameters
1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively without the requirement of field-installed sub-cooler or other forms of performance-enhancing booster devices.
  2. The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
  3. The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.
  4. The piping system shall be designed with pipe expansion and contraction possibilities in mind. Required expansion devices shall be field designed, supplied, and installed based on proper evaluation of the proposed piping design. In addition to these requirements, the piping system installation must conform to the VRF equipment manufacturer's published guidelines.
  5. The installation of pipe hangers, supports, insulation, and in general, the methods chosen to attach the pipe system to the structure must allow for expansion and contraction of the piping system and shall not interfere with that movement.
  6. The elevation difference between indoor units on <heat pump systems> shall be 131 feet.
  7. The elevation differences for heat recovery systems shall be:
  8. Heat recovery unit to connected indoor unit shall be 49 feet
  9. Heat recovery unit to heat recovery unit shall be 98 feet
  10. Indoor unit to indoor unit connected to same heat recovery unit shall be 49 feet
  11. Indoor unit to indoor unit connected to separate parallel piped heat recovery units shall be 131 feet.
  12. The acceptable elevation difference between two series-connected heat recovery units shall be 16 feet.
  13. Outdoor Unit
- H. Defrost Operations
- I. The outdoor unit(s) shall be provided with a minimum of 4 independent field adjustable defrost cycle algorithms to maximize the effectiveness of the defrost cycle to the local weather conditions. Intelligent Defrost shall melt accumulated frost, snow, and ice from the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient

temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables. Intelligent Heating Mode, when outdoor unit humidistat is engaged, shall extend the normal heating sequences by adjusting the outdoor unit coil target temperature to be above the ambient dew point temperature delaying the need for defrost operations, so long as heating demand is being met.

1. Smart Heating: This feature shall be capable of eliminating several defrost actions per day based on outdoor air temperature and humidity conditions. Smart heating shall extend the heating operation cycle by delaying the frost formation on the outdoor coil by adjusting the surface temperature to keep it above the current outdoor ambient dew point. The algorithm shall delay while maintaining indoor space temperature.
2. Defrost Mode Selection: The outdoor unit shall be provided with a minimum of three field selectable defrost operation modes: Normal, Fast, or Forced.
3. Normal Defrost: Operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the system's heating performance and maintain operational efficiency. When the ambient temperature is either: a) above 32°F or b) below 32°F with the humidity level below 60% RH, Intelligent Defrost shall continue heating regardless of ice build-up on the coil until the quality of the heated air (i.e. discharge air temperature) decreases. At temperatures below 4°F, a defrost cycle shall occur every two hours to optimize system heating efficiency.
4. Fast Defrost: Operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods based on current weather conditions to minimize energy consumption and maximize heating cycle time.
5. Forced Defrost: Operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.
6. Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods: Split Coil/Frame and Full System. Split Coil/Frame option provides continuous heating of the occupied space during defrost operation.
7. Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat recovery multi-frame outdoor units.
8. Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for a maximum time of six minutes, then the top half for a maximum of six minutes. Next, the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.
9. When Split Coil/Frame method is selected, a Full System defrost shall occur every 1-9 (field selectable) defrost cycles to assure 100% of the frozen precipitation has been removed to maintain efficient performance.
10. Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall be able to select the Full System only defrost method.

- J. Indoor Unit Fan Operation During Defrost
  - 1. During partial defrost operation, indoor units operating in cooling or dry mode shall continue normal operation.
  - 2. During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.
  - 3. . During full system defrost operation, indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.
- K. Oil Management
  - 1. The system shall utilize a high-pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to the compressor through a separate high-pressure oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed.
  - 2. Each compressor shall be provided with a high efficiency independent centrifugal cyclone type oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
  - 3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller. The sensor shall provide data to main outdoor unit PCB to start oil return mode and balance oil levels between multiple compressors
  - 4. The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor. The system shall display an error if the oil sensor signals low oil level for a period of 130 minutes or longer.
  - 5. A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
  - 6. Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
- L. Indoor Unit Fan Operation during Oil Return Cycle
  - 1. During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
  - 2. During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, th
  - 3. the fan speed will be reduced to low speed for the remainder of the oil return cycle.
  - 4. During oil return cycle, indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes.
- M. Fan and Motor Assembly
  - 1. 6-ton frames shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
  - 2. 8 to 20-ton frames shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
  - 3. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material and incorporate biomimetic technology to enhance fan performance and reduce fan-generated noise.
  - 4. The fan(s) motor shall be equipped with permanently lubricated bearings.

5. The fan motor shall be variable speed with an operating speed range of 0-1150 RPM cooling mode and 0-1150 RPM heating mode.
6. The fan shall have a guard to help prevent contact with moving parts.
7. The cabinet shall have the option to redirect the discharge air direction from vertical to horizontal with the addition of optional factory provided air guides.
8. The fan controller shall have a DIP switch setting to raise external static pressure of the fan up to 0.32 inch of W.C. to accommodate ducted installations.
9. The fan control shall have a function setting to remove excess snow automatically.
10. The fan control shall have a function setting to remove access dust and light debris from the outdoor unit and coil.

N. Cabinet

1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with weather and corrosion-resistant enamel finish. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours.
2. Cabinet weights and foot prints shall vary between 430 lbs., 7.61 sq. ft. (1.27 sq. ft. per ton), for 6-ton cabinet to 666 lbs., 10.14 sq. ft. (.51 sq. ft. per ton), for 20-ton cabinet for single cabinet configurations. The front panels of the outdoor units shall be a removable type for access to internal components.
3. A smaller service access panel, not larger than 7" x 7" and secured by a maximum of (2) screws, shall be provided to access the following:
  - a. Service tool connection
  - b. DIP switches
  - c. Auto addressing
  - d. Error codes
  - e. Main microprocessor
  - f. Inverter PCB
4. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front, right side, or through the bottom of the unit.
5. The cabinet shall have a factory-installed coil guard.

O. Outdoor Unit Coil

1. Outdoor unit coil shall be designed, built and provided by the VRF outdoor unit manufacturer.
2. The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin spacing of no more than 17 Fins per Inch (FPI). All the outdoor unit coils shall be a 2 or 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger
3. Outdoor unit coil shall be comprised of aluminum fins mechanically bonded to copper tubing with inner surfaces having a riffling treatment to expand the total surface of the tube interior
4. The aluminum fin heat transfer surfaces shall have factory applied corrosion resistant Black Fin coating. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
5. ISO 21207 Salt Spray Test Method B – 1500 hours
6. ASTM B-117 Acid Salt Test – 900 hours

7. The Black Fin coating shall be certified by Underwriters Laboratories and per ISO 21207. The above conditions shall establish the minimum allowable performance which all alternates must comply.
  8. Variable Path Heat Exchanger: System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the coil heat transfer capacity and efficiency. The variable path heat exchanger technology shall be provided to maintain stable refrigeration cycle operation during mild weather conditions and maintain a robust hot vapor temperature system head pressure that delivers “gas-furnace leaving air temperature” from the indoor unit at sub-zero outdoor air temperature down to minus (-) 22°F. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig.
- P. H. Compressor(s)
1. Compressor shall be designed and assembled by the VRF manufacturer specifically for use in the air source VRF product line. Third-party manufactured, branded, or designed to the VRF system’s OEM specifications by a third party manufacturer shall not be acceptable.
  2. Compressor shall be a hermetic, high-side shell (HSS), commercial grade, compliant scroll direct-drive design.
  3. Compressor Design: The compressor design shall be of the high-pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high-pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high-pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. Compressor shall have a nominal operating range from 12Hz to 150 Hz.
  4. The fixed and oscillating compressor scroll components shall be made of high grade (GC25) or denser steel material. All scrolls shall be heat treated and tempered.
  5. The oscillating scroll shall be finely machined and polished. PVE refrigerant oil shall be used as the sole liquid used to maintain a seal between the high and low sides of the compression chamber. Compressors that require the use of any type of mechanical or wearable sealant material between the moving surfaces of the compression chamber is NOT ACCEPTABLE.
  6. Vapor Injection: System shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor.
  7. Bearing surfaces shall be coated with Teflon® equal. Bearings shall be lubricated using a constant flow of PVE refrigerant oil to the bearing surfaces. The film of oil separating the crankshaft journals and bearing surfaces shall be consistent at all times the crankshaft is in motion and shall be maintained irrelevant of crankshaft rotational speed.
  8. An internal, integrated, mechanically driven gear pump shall draw oil from the compressor sump reservoir, pressurize the oil and inject the oil directly to the crankshaft

- journals maintaining a consistent film of oil between all moving parts. Auxiliary, indirect, or electronically driven pumps are not acceptable.
9. The viscosity property of the PVE oil in the compressor sump shall be maintained irrelevant of compressor operation and the surrounding ambient temperature.
  10. The compressor shall be equipped with an external thermally protected electric crankcase heater that is automatically activated only when the ambient temperature is below freezing and the compressor is not running to maintain the temperature of the oil in the sump above the refrigerant boiling point.
  11. During stable operation, irrelevant of ambient air temperature outside the water source unit, the temperature of refrigerant vapor in contact with the surface of the oil in the compressor sump shall be maintained above 140°F to prevent foaming and to eliminate refrigerant from mixing with the oil degrading the viscosity of the oil in the sump.
  12. Low side shell (LSS) type compressors that use suction vapor to cool the compressor motor shall not be acceptable.
  13. The compressor motor shall be designed to operate at high temperatures.
  14. The motor winding insulation shall be designed to operate continuously at a minimum temperature of 180°F without deterioration.
  15. The motor cooling system shall be designed to maintain acceptable operational temperature at all times and in all conditions using high pressure, hot refrigerant vapor as motor coolant.
  16. Low side shell (LSS) and compressors that use low pressure, low temperature refrigerant gas to cool the motor are not acceptable.
  17. Inverter Compressor Controller(s)
    - a. Each compressor shall be equipped with a dedicated inverter compressor drive. The control of multiple compressors using a single drive is not acceptable.
    - b. The inverter drive shall vary the speed of the compressor crankshaft between zero (0) Hz and 140 Hz.
    - c. The inverter driver controller shall be matched with the physical properties of the compressor. The drive shall be manufactured by the VRF air source unit manufacturer. The inverter drive and matching compressor shall have been thoroughly tested as a matched pair. The inverter drive shall be programmed to avoid operating the compressor at any speed that results in harmonic vibration, nuisance noise, or mechanical damage to either the driver or the compressor with power provided that is within the tolerance specification.
    - d. The compressor inverter drive assembly and software must be designed, manufactured, and supplied by the VRF product manufacturer. Third party branded inverter driver hardware and/or driver software or inverter driver hardware and/or software provided by a third party manufacturer to meet OEM specifications of the VRF water source manufacturer will not be acceptable.
    - e. All inverter drive hardware or software manufactured in, is a product of, or sourced from China, or using a broker or third party provider as an intermediary that obtains the product from CHINA shall not be acceptable.

### **2.03 Compressor(s)**

- A. Each 6, 8, 10 ton frames shall be equipped with a single hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.



- B. 12, 14, 16, 18 and 20 ton frames shall be equipped with dual hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressors.
- C. Each inverter driven, HSS scroll compressor shall be capable of operating from 12 Hz up to 150 Hz in any and all modes (cooling, heating or simultaneous modes).
- D. The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.
- E. The compressor bearing(s) shall have Teflon™ coating and shall be an aero type design using High lubricity materials.
- F. The compressor(s) shall be protected with:
  - 1. High Pressure switch
  - 2. Over-current /under current protection
  - 3. Oil sump sensor
  - 4. Phase failure
  - 5. Phase reversal
- G. Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability. The VRF outdoor unit shall have published performance data for heating mode operation down to -22°F on both heat pump and heat recovery systems.
- H. Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.

#### **2.04 Operational Sound Levels**

- A. The compressor(s) shall be mounted on rubber isolation grommets. Compressor shall ship with removable clamps that secure the compressor in place while transported. The installing contractor shall remove and discard (or optionally adjust the clamps to allow the isolator to properly function) the clamps prior to commissioning the water source unit.
- B. Each single frame outdoor unit shall be rated with an operational sound pressure level not to exceed as listed on below chart when tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available. Such documentation shall be presented in all submittals, manufactures who elect to rate their equipment at other than tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available and the highest field selectable conditions shall not be allowed.
- C. field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement. This mode is available in both cooling and heating modes.

#### **2.05 Sensors**

- A. Each outdoor unit module shall have:
  - 1. Suction temperature sensor
  - 2. Discharge temperature sensor
  - 3. Oil level sensor
  - 4. High Pressure sensor
  - 5. Low Pressure sensor

6. Outdoor temperature sensor
7. Outdoor humidity sensor
8. Outdoor unit heat exchanger temperature sensors

## **2.06 Wind Load Installations for Outdoor Units**

1. Provide Load Installation Drawings that meet the requirements of ASCE Standard 7-2010 with submittal

## **2.07 Seismic Installations**

- A. Provide with submittal: 1) OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. 2) Equipment installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.

## **2.08 Heat Recovery Units (Heat Recovery Systems Only) General**

- A. Heat recovery unit shall be designed and manufactured by the same manufacturer of VRF indoor unit(s) and outdoor unit(s).
- B. Heat recovery unit casing shall be constructed with galvanized steel.
- C. Heat recovery unit shall require 208-230V/1-phase/60Hz power supply.
- D. Heat recovery Unit shall be an intermediate refrigerant control device between the air source outdoor unit and the indoor units to control the systems cooling and heating operation.
- E. Heat recovery unit shall be engineered to work with a three pipe VRF system comprising of:
- F. High Pressure Vapor Pipe
- G. Low Pressure Vapor Pipe
- H. Liquid Pipe
  1. Heat recovery units' main 3 pipe connections shall be capable of series or parallel pipe configuration.
  2. The quantity of heat recovery units that can be piped in series shall be limited to 16.
- I. Heat recovery units shall be engineered for installation in a semi-conditioned space where temperature and humidity is maintained between -22Deg F to 130Deg F. Heat recovery unit's case and internal components where surface temperatures may operate below dew point shall be factory insulated. Heat recovery units that condense and require condensate drain shall not be acceptable.
  1. A single string of series piped heat recovery units shall be capable of serving any combination of styles of VRF indoor units with a combined nominal capacity of up to 230 MBh.
  2. Heat recovery unit shall have 2, 3, 4, 6 or 8 ports, each port supporting one or more indoor units with a maximum connected capacity of 60 MBH.
  3. Each port shall be capable of operating in cooling or heating independently regardless of the operating mode of any other port on the heat recovery unit or in the system.
  4. Each port shall be capable of connecting from 1 to 8 indoor units.
  5. Connection to indoor units totaling greater than 60MBh nominal capacity shall be twinned to two adjacent ports of the heat recovery unit using a reverse Y-branch connector supplied by the manufacturer.

6. Heat recovery unit shall be internally piped, wired, assembled, and run tested at the factory.
7. Heat recovery unit shall be designed for installation in a conditioned environment per specifications.
8. Heat recovery unit shall employ a liquid bypass valve.
9. Heat recovery unit shall have (2) electronic expansion refrigerant valves per port.
10. Heat recovery unit shall have a balancing valve to control the pressure between the high pressure and low-pressure pipe during mode switching to minimize any changeover pressure related sounds.
11. Heat recovery unit shall employ an electronic expansion valve to ensure proper sub cooling of the refrigerant.
12. Heat recovery unit shall contain one double spiral sub-cooling heat exchanger per port.
13. Heat recovery unit shall not require a condensate drain or connection.
14. Heat recovery unit shall be internally factory insulated.
15. All field refrigerant lines between outdoor unit and heat recovery unit and from heat recovery unit to indoor unit shall be field ACR tubing, insulated per building or energy code and as instructed by the manufacture.
16. X. The heat recovery unit shall not exceed a net weight of 68 lbs.
17. Y. Heat recovery units, for line length and pressure drop calculations, shall not exceed a maximum equivalent pipe length value of 8.2 feet.
18. Z. The VRF manufacturer shall provide published documentation that specifically allows the installation of field provided isolation valves on all pipes connected to the Heat recovery unit to allow the servicing of heat recovery units, refrigerant circuit or the replacement of heat recovery unit without evacuating the balance of the piping system.

## **2.09 Controls**

- A. Heat recovery unit(s) shall have factory installed unit mounted control boards and integral microprocessor to communicate with other devices in the VRF system.
- B. Heat recovery unit shall communicate with the indoor units via a 2-conductor stranded communications cable terminated using a daisy chain configuration.
- C. The contractor is instructed to review the Electrical and ATC drawings and specifications for other items or tasks which this contractor is or may be responsible to provide materials and or labor under this contract. Failure to do so will not relieve this contractor of their responsibility to provide such materials and or labor and in no case shall this contractor be further compensated as a result.
- D. Seismic Installations
  1. Provide with submittal: 1) OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. 2) Equipment installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.
  2. INTEGRATION - LG MULITSITE™ COMMUNICATIONS MANAGER: PBACNBTR0A
  3. The Communication Manager provides multiple energy management schemes and integrates with third-party Building Automation Systems via BACnet, LON and Fox protocols. The LG Communication Manager shall be configurable via a standard web browser requiring no additional software. Additionally, the LG MultiSITE

Communication Manager shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.

4. General:
  - a. The LG MultiSITE Communication Manager shall communicate to the Multi V VRF indoor unit via the VRF RS-485 daisy chain communication protocol.
  - b. The LG MultiSITE Communication Manager shall be shipped pre – configured to communicate with the Multi V VRF indoor unit via the VRF RS-485 daisy chain communication protocol.
  - c. The LG MultiSITE Communication Manager shall have web browser graphical user interface access with user control.
  - d. The LG MultiSITE Communication Manager shall have operation, alarm, user and error history log with reporting and exporting capabilities.
  - e. The LG MultiSITE Communication Manager shall be able to monitor and control up to 128 indoor units in groups or as a single zone.
  - f. The LG MultiSITE Communication Manager shall have two setpoint auto changeover.
  - g. The LG MultiSITE Communication Manager shall have occupied/unoccupied setpoint control.
  - h. The LG MultiSITE Communication Manager shall have remote zone controller lockout (Setpoint, Mode).
  - i. The LG MultiSITE Communication Manager shall be able to support registration as a foreign device
  - j. BACnet is a trademark of ASHRAE.

E. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Auto/Dry)	X	X
Set Point	Space temperature setpoint for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature through graphical interface	X	X
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Group Control	Control and Monitor a group or multiple groups	X	X
Selectable Temperature	Degree °F or Degree °C		

F. Available functions/features may differ based on connected system. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Daily, Weekly, Yearly and Holiday programmable schedule Minimum of 5 events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan	X	X
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption.	X	X
Operation Run Time Limit	Limit the run time of an indoor unit	X	X
Auto Changeover Deadband Adjust	Automatically manage room temperature for heating and cooling	X	X
Web Browser Interface	Graphical web browser interface	X	X

G. Available functions/features may differ based on connected system.

1. Electrical:

- a. LG MultiSITE Communication Manager Power shall be 24VAC.
- b. LG MultiSITE Communications Manager Power shall be 120VAC with wall adapter.

H. VRF AHU Conversion Kit – Electronic Expansion Valve (EEV) Kit

1. General

- a. Unit shall be manufactured by LG.
- b. Unit shall be factory assembled and wired unit shall be designed to be installed indoors only.
- c. Unit shall be capable to be installed with heat pump or heat recovery VRF system, 8 ton maximum coil circuit.
- d. Unit requires one communication kit to provide power and control signals.
- e. Unit shall connect liquid line piping from outdoor unit to AHU coil.\

2. Casing/Cover

- a. Carbon steel casing with removable cover secured by (4) screws
- b. The external surface shall be finished with a high gloss baked enamel finish, morning fog color
- c. Internal zinc plated mounting plate supporting insulated EEV assembly and terminal block with ABS enclosure
- d. Open bottom panel for refrigerant pipe and control wiring
- e. Four predrilled mounting holes at rear panel for attachment to AHU

3. Electrical

- a. Six conductor, 18 GA shielded and stranded field supplied wiring for 12 volt (low voltage) power and control signal from communication kit
- 4. Limited Warranty
  - a. Please refer to the respective outdoor unit for applicable warranty.

**2.10 EEV Kit (PRLK096A0) – 9 to 16 tons capacity**

- A. General:
  - 1. Unit shall be manufactured by LG.
  - 2. Unit shall be factory assembled and wired unit shall be designed to be installed indoors only.
  - 3. Unit shall be capable to be installed with heat pump VRF system, 16 ton maximum coil circuit.
  - 4. Unit requires one communication kit to provide power and control signals.
  - 5. Connects liquid line piping from outdoor unit to AHU coil.
- B. Casing/Cover
  - 1. Carbon steel casing with removable cover secured by (4) screws
  - 2. The external surface shall be finished with a high gloss baked enamel finish, morning fog color
  - 3. Internal zinc plated mounting plate supporting insulated EEV assembly and terminal block with ABS enclosure
  - 4. Open bottom panel for refrigerant pipe and control wiring
  - 5. Four predrilled mounting holes at rear panel for attachment to AHU
- C. Electrical:
  - 1. Six conductor, 18 GA shielded and stranded field supplied wiring for 12 volt (low voltage) power and control signal from communication kit
- D. Limited Warranty
  - 1. Please refer to respective outdoor unit for applicable warranty.
  - 2. or applicable warranty.

**2.11 AHU Communication Kit PAHCMR00**

- A. AHU Communication Kit PAHCMR00
- B. General
  - 1. Unit shall be manufactured by LG.
  - 2. Unit shall be factory assembled and wired.
  - 3. Unit shall be designed to be installed for indoor or outdoor.
  - 4. Unit shall be capable to be installed with heat pump or heat recovery VRF system.
  - 5. Allows communication between third party air handling unit (AHU) and LG Multi V air-source or water-source outdoor units with combination ratio between 50% to 100%.
  - 6. Requires one EEV kit to control the flow of refrigerant from Multi V outdoor unit to AHU coil.
- C. Casing/Door
  - 1. Carbon steel housing and door
  - 2. Unit case shall have a light grey finish, powder coated
  - 3. NEMA 4 enclosure

4. Hinged front door with (1) key operated lock
  5. Foamed in polyurethane door seal
  6. Internal zinc plated mounting plate supporting spring push pin type terminal microprocessor control board
  7. Four wiring knockouts located at bottom of panel
  8. Four predrilled mounting holes at rear panel for attachment to AHU
- D. Microprocessor Control:
1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
  2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
  3. The unit controls shall operate the AHU using one of the following operating modes:
    - a. Heating
    - b. Cooling
    - c. Fan only
  4. AHU coil entering air operating temperature limit
    - a. Cooling mode: 64°F to 104°F D
    - b. Heating mode: 41°F to 86°F DB
  5. Protection logic to turn off ODU at the following AHU coil entering air temperatures (can be bypassed by replacing return air thermistor with 10K Type 2 resistor, when discharge air control is being used)
  6. Requires 3<sup>rd</sup> party AHU controller that can control AHU fan and send/accept the following signals:
  7. Output signals
    - a. Analog: (0-10 volt) to control ODU capacity between 0 and 100%
    - b. Digital: Thermal On/Off (open/close the EEV)
    - c. Digital: Mode Change
  8. Input signals
    - a. Running status
    - b. Compressor status
    - c. Running mode
    - d. Error status
  9. EEV control:
    - a. Adjusts EEV position based on superheat temperatures as monitored from the evaporator coil pipe in/out thermistors
    - b. Six conductor 18 GA shielded and stranded field supplied wiring for 12 volt (low voltage) power and control and signal to EEV kit
    - c. Electrical:
  10. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
    - a. The unit shall be capable of operating within voltage limits of +/- 10%
  11. Thermistors:
    - a. One air temperature thermistor, shipped loose for field mounting at mixed return air side of AHU coil
    - b. One evaporator coil pipe inlet temperature thermistor, shipped loose for field mounting between EEV kit and evaporator coil

- c. One evaporator coil pipe outlet temperature thermistor, shipped loose for field mounting
  - 12. Capacity options
    - a. Capacity options to match AHU coil load shall be selectable by adjusting dip switch settings.
    - b. Seventeen optional capacities shall be available in the following sizes:
      - 1) 12 MBH
      - 2) 15 MBH
      - 3) 18 MBH
      - 4) 24 MBH
      - 5) 28 MBH
      - 6) 36 MBH
      - 7) 42 MBH
      - 8) 48 MBH
      - 9) 54 MBH
      - 10) 76 MBH
      - 11) 96 MBH
      - 12) 115 MBH
      - 13) 134 MBH
      - 14) 153 MBH
      - 15) 172 MBH
      - 16) 192 MBH
      - 17) 396 MBH
  - 13. Optional Controls:
    - a. LG programmable thermostats
- E. PREMTA000
  - 1. LG Central Controllers: ODU can be viewed and controlled by the following central controllers connected to outdoor units:
  - 2. MultiSITE Communications Manage

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas, with Installer present, to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install VRF equipment level and plumb.
- B. Install VRF equipment to comply with NFPA 90A.
- C. Install ground-mounted, compressor-condenser components on 4-inch-thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork



are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

- D. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Suspend indoor fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- G. Verify mounting height detail is on the project drawings
- H. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.

### **3.03 FIELD-INSTALLED REFRIGERANT PIPING**

- A. See Specification section 23 23 00 Refrigerant Piping.

### **3.04 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform tests and inspections. Many times the installing contractor has factory training and paragraph below this one is appropriate.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Retain first subparagraph below if units have electric heat. Not common in SoCal.
  - 3. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 4. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.

### **3.05 ADJUSTING**

- A. Humidity control is uncommon.
  - 1. Adjust initial temperature and humidity set points.
  - 2. 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.

**3.06 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain system.

**END OF SECTION**

**SECTION 26 00 10**  
**BASIC ELECTRICAL REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 1.
- B. Definitions, guarantees, submittals, clean-up, "As-Built" and all other applicable requirements of and Division 1 apply to the work of this section.
- C. Related Sections:
  - 1. Section 09 91 13: Exterior Painting
  - 2. Division 23: Mechanical.

**1.02 BASIC ELECTRICAL REQUIREMENTS**

- A. Quality Assurance:
  - 1. Workers possessing the skills and experience obtained in performing work of similar scope and complexity shall perform the Work of this Division.
  - 2. Refer to other sections of the Specifications for other qualification requirements.
- B. Drawings and Specifications Coordination:
  - 1. For purposes of clearness and legibility, Drawings are essentially diagrammatic and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.
  - 2. Verify final locations for rough-ins with field measurements and with the requirements of the equipment to be connected.
  - 3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduit. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
  - 4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.
  - 5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity.
  - 6. Coordinate electrical equipment and materials installation with building components and the Work of other trades.
  - 7. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
  - 8. Coordinate connection of electrical systems with existing underground utilities and services.

- C. Terminology:
1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.
  2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
  3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.
- D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.
- E. Structural Considerations for Conduit Routing:
1. Where conduits pass through or interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, conform to ACI 3.8-11 Section 6.3 for conduits and pipes embedded in concrete and Section 2308.9.10 for notches and bored holes in wood; for steel, as detailed on the structural steel Shop Drawings.
  2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, encasement shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, if any, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.
  3. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled with the conduit nipple or coupling welded to poles. Welds shall be provided by the electric arc process and shall be continuous around nipple or coupling.
- F. Electrically Operated Equipment and Appliances:
1. Furnished Equipment and Appliances:
    - a. Work shall include furnishing and installing wiring enclosures for, and the complete connection of electrically operated equipment and appliances and electrical control devices which are specified to be furnished and installed in this or other sections of the Specifications, wiring enclosures shall be concealed except where exposed Work is indicated on the Drawings.
    - b. Connections shall be provided as necessary to install equipment ready for use. Equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets are of incorrect electrical characteristics or any specified equipment fails to operate properly, repair and/or replace the outlet and/or equipment.
  2. Equipment and Appliances Furnished by Others:
    - a. Equipment and appliances indicated on Drawings as "not in contract" (NIC), "furnished by others," or "furnished by the Owner," will be provided. Required

electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.

- b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems with 120V, single phase circuit from nearest electrical panel, furnished under Division 26. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.
- c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
- d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
- e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.

G. Protection of Materials:

- 1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.

H. Cleaning:

- 1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
- 2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
- 3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

### 1.03 WARRANTIES

- A. Provide one year warranty on all work performed, unless noted otherwise in specific sections.

### 1.04 DISCREPANCIES

- A. Where a conflict in requirements occurs between the specifications and drawings, or in the specifications or on the drawings, and a resolution is not obtained from the Engineer before the bidding date, the more expensive alternate will become the contractual requirement.

- B. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.
- C. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Engineer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

### **1.05 SUBMITTALS**

- A. Submit shop drawings, manufacturer's data certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval. Contractor shall be responsible for reviewing and certifying submittals as conforming to the drawings and specifications prior to submittal and shall verify conformance of equipment as delivered with final shop submittals, specifications and plans. Contractor shall report to Engineer any deviations prior to initiation of construction. Contractor is responsible for promptly reporting to Architect any news of late equipment delivery which is likely or certain to delay installation.
  - 1. Submit shop drawings and product data grouped and referenced by the technical Section numbers. Products must be highlighted on the product data sheets.
  - 2. Submittal/shop drawing shall consist of cover sheet with specification number and the submitted products within the submittal shall be highlighted. Submittals shall be grouped per the related specification number.
  - 3. Proposed Products List: Include Products as required by the individual section in this Division.
  - 4. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Engineer bearing the electrical engineer's stamp of "reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site when required by the Engineer, without additional compensation.
  - 5. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size with a minimum scale of 1/8-inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, duct work, and other items that must be shown to assure a coordinated installation. In wiring diagrams, identify circuit

terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

6. **Manufacturer's Data:** For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
7. **Standard Compliance:** When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or Underwriters' Laboratories (UL), submit proof of such conformance to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
8. **Certified Test Reports:** Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
9. **Certificates of Compliance or Conformance:** Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Manufacturer shall use Form 260010-A for equipment installation certification. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

#### **1.06 GUARANTEE**

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed. Furnish manufacturer's warranties for all equipment furnished under this project.

### **1.07 MANUFACTURER'S RECOMMENDATIONS**

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

### **PART 2 PRODUCTS (NOT APPLICABLE)**

### **PART 3 EXECUTION**

#### **3.01 GENERAL REQUIREMENTS**

- A. Advise the IOR before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.
- D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the IOR. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be 3 inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. Contractor to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- F. Electrical equipment shall be braced and anchored per 2016 CBC CH 16A, Section 1616A.1.23 through 1616A.1.26 seismic requirements, or as otherwise indicated on the Drawings.

#### **3.02 WORK RESPONSIBILITIES**

- A. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgement 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 with structural conditions. The contractor is responsible for the correct placing of his work and the proper location and connection of his work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- B. 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 extra cost, providing the change is ordered before the conduit runs, etc. and work directly connected to same is installed and no extra materials are required.
- C. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.



- D. Do not install light outlets or fixtures until mechanical piping and duct work is installed; then lights shall be installed in locations best suited for equipment arrangement or as directed by the Engineer.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the shop drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Engineer immediately and cease work on all parts of the contract which are affected until approval for any required modifications to the construction has been obtained from the Engineer.
- G. Be responsible for any cooperative work which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Engineer and shall be made to his satisfaction.
- H. Perform all work with competent and skilled personnel.
- I. All work, including aesthetic as well as electrical and mechanical aspects of the work, shall be of the highest quality consistent with the best practices of the trade.
- J. Replace or repair, without additional compensation, and any work which, in the opinion of the Engineer, does not comply with these requirements.

### **3.03 OPERATION AND MAINTENANCE MANUAL**

- A. Provide operation and maintenance manual of all equipment and lighting fixtures furnished on this project

### **3.04 POSTED OPERATING INSTRUCTIONS:**

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

### **3.05 MANUFACTURER'S RECOMMENDATIONS:**

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

### **3.06 DELIVERY STORAGE AND HANDLING**

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

### **3.07 CUTTING AND PATCHING**

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work, or surfaces damaged as a result of the work performed under this contract.

### **3.08 CLEANUP**

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.
- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the Owner Authorized Representative.

### **3.09 PROTECTION**

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

**END OF SECTION**

**SECTION 26 00 60**  
**ELECTRICAL DEMOLITION**

**PART 1 GENERAL**

**1.01 RELATED SECTIONS**

- A. Section 02 41 00 - Demolition

**PART 2 PRODUCTS**

**2.01 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on informal field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

**3.02 PREPARATION**

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate electrical outages with the Campus. Contractor shall notify the Owner of any power outages a minimum of two weeks in advance, and shall only occur if approved by the Owner in writing.
- C. Provide temporary wiring and connections to maintain existing systems in-service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

**3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK.**

- A. Project consist of multiple phase work, refer to architectural drawings and single line diagram for sequence of work.
- B. Demolish and extend existing electrical work under provisions of this Section and as indicated on the drawings.
- C. Remove, relocate, and extend existing installations to accommodate new construction.
- D. Remove abandoned wiring to source of supply unless otherwise indicated.
- E. Remove exposed abandoned conduit. Cut conduit flush with walls and floors, and patch surfaces.
- F. Disconnect and remove abandoned distribution equipment.

- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- I. Extend existing installations using materials and methods as specified in Section 26 05 33, "Raceways and Boxes for Electrical Systems."

#### **3.04 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment which remain or are to be reused.

**END OF SECTION**

**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**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. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
  - 1. Section 260533 "Raceways and Boxes for Electrical Systems"
  - 2. Section 260553 "Identification for Electrical Systems."

**1.03 DEFINITIONS**

- A. ASTM: American Society of Testing Materials.
- B. ICEA: Insulated Cable Engineers Association.
- C. IEEE: Institute of Electrical & Electronics Engineers.
- D. NEMA: National Electrical Manufacturers Association.
- E. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- F. VFC: Variable frequency controller.

**1.04 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data for each type of product, indicating conductor/cable construction, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of conductor/cable specified, splices and terminations. Indicate date and place of manufacture for each conductor/cable, cable, splice and termination.
- B. Manufacturer's ISO certification.

**1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Independent Testing Agency.
- B. Field quality-control reports. Perform field testing of cables per para 3.8. Submit six (6) copies of field test reports to owner's representative within two (2) weeks of completion of test.

**1.06 QUALITY ASSURANCE**

- A. General Requirements: The low voltage power conductors and cable shall be copper, minimum 600V rated unless otherwise indicated. Aluminum conductors and cables shall not be accepted unless otherwise indicated.

- B. Materials and installation shall meet or exceed requirements in the following referenced standards and shall be listed and labelled by UL.
  - 1. ICEA S-93-639/ NEMA WC 74.
  - 2. AEIC CS8.
  - 3. UL 1072.
  - 4. IEEE.
  - 5. ASTM.
  - 6. NEMA.
- C. Conductors and cables shall be of the same manufacturer, and shipped to the job site in original unbroken reels.
- D. Conductors and cables shall be manufactured within twelve (12) months of installation. Date of manufacture shall be clearly marked on conductors or conductor reels.
- E. Manufacturer shall have minimum ten (10) years experience in the manufacture of conductors and cables similar to those specified on this project.
- F. Manufacturer shall have ISO 9001 and ISO 9002 certification.
- G. All conductors and cables shall be new and supplied by a local distributor.
- H. American made conductors and cables have been acceptable. If non-domestic product is submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. All of the testing procedures and results shall be satisfactory to the Owner's representative. The Contractor shall bear all costs for testing and shall be responsible for all costs associated with travel, lodging, etc. for the Owner's Representative to witness the test at the manufacturer's testing facility. The Contractor shall reimburse the Owner at \$1,200 per man day or part thereof for the time required to witness the testing.
- I. Testing: Provide the services of an independent qualified testing laboratory to perform the specified field tests. Notify the Owner's Representative fourteen (14) days in advance of performance of work requiring testing.
- J. Conductors, cables, splices and terminations shall be manufactured within twelve (12) months of installation. Each item shall have a permanent marking on the product or the original manufacturers' package indicating the date of manufacture unless otherwise noted.
- K. Testing Agency Qualifications:
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of low voltage electrical power conductors and cables similar to those specified on this project.
  - 2. Testing company shall be located within 50 miles radius of the project.
  - 3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
  - 4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of low voltage power conductors and cables of the type and rating similar to the conductors and cables to be tested on this project.

## **PART 2 PRODUCTS**

### **2.01 CONDUCTORS AND CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. General Cable Technologies Corporation.
  - 2. Southwire Incorporated
  - 3. Alpha Wire.
- B. Conductor Material: Electrical grade, soft drawn annealed copper, 98 percent conductivity, and fabricated in accordance with ASTM and IPCEA standards. Minimum size is number 12 for branch circuits, number 14 stranded for control wiring. Aluminum conductors are not permitted. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2 or Type XHHW-2.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Type SO and with ground wire.
- E. VFC Cable:
  - 1. Comply with UL 1277, UL 1685, and CEC for Type TC-ER cable.
  - 2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.
  - 3. Comply with UL requirements for cables in direct burial applications.
- F. Provide separate neutral with each branch circuit serving outlets. When dedicated neutrals are provided, use color spiral to match associated phase.

### **2.02 CONNECTORS AND SPLICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. Ideal Industries, Inc.
  - 2. IlSCO; a branch of Bardes Corporation.
  - 3. NSi Industries LLC.
  - 4. O-Z/Gedney; a brand of the EGS Electrical Group.
  - 5. 3M; Electrical Markets Division.
  - 6. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Copper conductors shall be terminated in copper or bronze mechanical connectors or lugs or tool applied compression connections made of copper for all connections except those on wiring devices.
- D. Splices in wires No. 10 and smaller shall be made with twist-on splicing connector in accordance with UL486-C. Connections in wires No. 8 and larger shall be made with compression type connectors in accordance with UL486-A and wrapped with insulated tape in

accordance with UL501. Insulating tape shall be applied in a minimum of two layers of half wrap or built to match the overall insulation of the wire.

- E. Splices in underground pull boxes shall be made submersible type and made using "3M" Scotch-cast epoxy kits.
- F. Pressure type connectors are not permitted.

### **2.03 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- B. Comply with CEC.

## **PART 3 EXECUTION**

### **3.01 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### **3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN-2, single conductors in raceway
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. VFC Output Circuits: Type XHHW-2 in metal conduit with braided shield.

### **3.03 INSTALLATION OF CONDUCTORS AND CABLES**

- A. All conductors and cables shall be installed in a raceway.
- B. Before installing conductors and cables in existing conduits, verify the continuity of each conduit; each surface conduit is properly supported per code and clear of any debris.



- C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

### **3.04 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors].
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### **3.05 IDENTIFICATION**

- A. Each conductor shall be factory color coded by conductor manufacturer. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.07 FIRESTOPPING**

- A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078400 "Fire stopping."

### **3.08 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors, feeder conductors and the conductors feeding the following critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical tests stated in latest NETA Acceptance Testing Specification section 7.3.2 (Inspection and Test Procedures-Cables, Low Voltage-600V Maximum). Certify compliance with test parameters per NETA tables.
  3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:
1. Procedures used.
  2. Results that comply with requirements. Include color scan images.
  3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

**END OF SECTION**

**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Retain or delete this article in all Sections of Project Manual.
- B. 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: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Overhead-line grounding.
  - 2. Underground distribution grounding.
  - 3. Ground bonding common with lightning protection system.

**1.03 DEFINITIONS:**

- A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- B. NETA MTS: InterNational Electrical Testing Association - Maintenance Testing Specification.
- C. CEC: California Electrical Code

**1.04 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's technical catalog cuts for each type of product indicated.
- B. Shop Drawings: Site drawings to scale including details showing location and size of each field connection of grounding system.
  - 1. Wiring Diagrams: Differentiate between manufacturer installed and field installed wiring.

**1.05 INFORMATIONAL SUBMITTALS**

- A. Informational Submittals: Plans drawn to scale (1/4"=1'-0") showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding conductors, connectors.
  - 5. Grounding arrangements and connections for separately derived systems.
  - 6. Grounding for sensitive electronic equipment.

- B. Qualification Data: For qualified independent testing agency and testing agency's field supervisor.
- C. Field quality-control reports. Submit written test reports including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. include the following:
  - 1. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
    - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    - b. Include recommended testing intervals.

#### **1.07 QUALITY ASSURANCE**

- A. Testing Agency Qualifications:
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of grounding systems similar to those specified on this project.
  - 2. Testing company shall be located with 50 miles radius of the project.
  - 3. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
  - 4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of rounding systems of the type and rating similar to the systems to be tested on this project.
- B. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

### **PART 2 PRODUCTS**

#### **2.01 GROUNDING ELECTRODES, CONDUCTORS, CONNECTOR, BUS:**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
  - 1. Grounding Connectors, Bars and Rods:

- a. Erico Inc.; Electrical Product Group
  - b. Framatome Connectors/Burndy Electrical.
  - c. Ideal Industries, Inc.
  - d. O-Z/Gedney Co.; a business of the EGS Electrical Group.
  - e. Thomas & Betts, Electrical.
2. Grounding Conductors and cables:
- a. Southwire
  - b. American Insulated Wire
  - c. Okonite

## 2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
  - 1. No. 4 AWG minimum, soft-drawn copper.
  - 2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.
- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

## 2.03 CONNECTORS

- A. Listed and labeled by UL for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

#### **2.04 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet in length.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
  - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
  - 2. Backfill Material: Electrode manufacturer's recommended material.

### **PART 3 EXECUTION**

All grounding shall be in accordance with CEC article 250.

#### **3.01 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### **3.02 GROUNDING OVERHEAD LINES**

- A. Comply with IEEE C2 grounding requirements.
- B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

### **3.03 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- C. Install #4/0 bare copper ground wire loop around the outside perimeter of the manhole, in soil, 12" above bottom of manhole. Cadweld ground wire loop to #4/0 bare copper ground wire connecting all exposed metal parts inside the manhole through a 1" opening at the top of manhole wall. Seal and waterproof opening after wire installation.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- E. Pad-Mounted Transformers and Medium Voltage Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 1/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### **3.04 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits in the same conduit containing phase and neutral conductors. Comply with CEC, Article 250, for

types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by CEC are indicated.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC :
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
  10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment. Verify requirements with X-ray equipment supplier prior to rough-ins.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.



1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
4. All metallic conduits and cable tray shall be continuously bonded to maintain low resistance ground path and bonded back to the central equipment by the use of bonding jumpers where needed.

### **3.05 INSTALLATION**

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  1. Interconnect ground rods with grounding electrode conductor below grade using exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  2. For grounding electrode system, install ground rods at least three rods, spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Separately Derived System (SDS): All multiple branch metal water piping laterals originating from outside the area being served by the SDS and which serve the same area being served by the SDS shall be bonded to the common grounding electrode (GE) or the common grounding electrode conductor (GEC). The bonding connection shall be made at each level that the metal water piping serves. When multiple SDS's are installed or a SDS serves multiple levels of a structure, a copper common GEC shall be installed for the SDS as permitted in CEC article 250.30 (D)3 and sized per article 250.30 (A) and (B).
  3. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  4. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to CEC; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

### 3.06 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
  1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### 3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections. Refer to section
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
  - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
  - 3. Substations and Pad-Mounted Equipment: 5 ohms.
  - 4. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner's Representative promptly and include recommendations to reduce ground resistance.

**END OF SECTION**



**SECTION 26 05 33**  
**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**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. Metal conduits, tubing, and fittings.
  - 2. Nonmetal conduits, tubing, and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Nonmetal wireways and auxiliary gutters.
  - 5. Surface raceways.
  - 6. Boxes, enclosures, and cabinets.
  - 7. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
  - 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

**1.03 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. EMT: Electrical metal tubing
- C. ENT: Electrical non-metallic tubing
- D. GRC: Galvanized rigid steel conduit.
- E. HDPE: High density polyethylene pipe
- F. IMC: Intermediate metal conduit.
- G. LFMC: Liquidtite flexible metal conduit
- H. LFNC: Liquidtite flexible non-metallic conduit.
- I. RNC: Rigid non-metallic conduit
- J. RTRC: Reinforced thermosetting resin conduit

**1.04 QUALITY ASSURANCE:**

- A. Each conduit shall bear manufacturer's trademark and UL label.
- B. Each type of conduit and fittings shall be of a single manufacturer. Multiple manufacturer's of the same material are not acceptable.
- C. Comply with California Electric Code (CEC)

### 1.05 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:
  - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive 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."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches long.

### 1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

## PART 2 PRODUCTS

### 2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. O-Z/Gedney; a brand of EGS Electrical Group.
  - 3. Republic Conduit.

4. Robroy Industries.
  5. Thomas & Betts Corporation.
  6. Western Tube and Conduit Corporation.
  7. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be UL listed and labeled as defined in NFPA 70, and marked for intended location and application.
  - C. GRC: Comply with ANSI C80.1 and UL 6.
  - D. ARC: Comply with ANSI C80.5 and UL 6A.
  - E. IMC: Comply with ANSI C80.6 and UL 1242.
  - F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
    1. Comply with NEMA RN 1.
    2. Coating Thickness: 0.040 inch, minimum.
  - G. EMT: Comply with ANSI C80.3 and UL 797.
  - H. FMC: Comply with UL 1; zinc-coated steel.
  - I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
  - J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
    1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and CEC.
    2. Fittings for EMT:
      - a. Material: Steel.
      - b. Type: Compression.
    3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
    4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
  - K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in CEC, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. CANTEX Inc.
  2. Condux International, Inc.
  3. Electri-Flex Company.
  4. Lamson & Sessions; Carlon Electrical Products.
  5. RACO; a Hubbell company.
  6. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.

- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.
- L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- M. Solvent cements and adhesive primers 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."

### **2.03 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 for indoor dry locations and Type 4X stainless steel for outdoor, damp and wet locations unless otherwise indicated, and sized according to CEC. Metal wireways installed outdoors shall be UL listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated. Refer to drawings for additional information.
- E. Finish: Manufacturer's standard enamel finish.

### **2.04 SURFACE RACEWAYS**

- A. Listing and Labeling: Surface raceways and tele-power poles shall be UL listed and labeled as defined in NFPA 70, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Hubbell Wiring Systems
  - b. Wiremold / Legrand.
  - c. Mono-Systems, Inc.
  - d. Panduit Corp.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems Division.
    - b. Wiremold / Legrand.
    - c. Mono-Systems, Inc.
    - d. Panduit Corp.
- D. Tele-Power Poles:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems Division
    - b. Wiremold / Legrand.Mono-Systems, Inc.
    - c. Panduit Corp.
  - 2. Material: Aluminum with clear anodized finish.
  - 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

## **2.05 BOXES, ENCLOSURES, AND CABINETS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 2. EGS/Appleton Electric.
  - 3. Hoffman; a Pentair company.
  - 4. Hubbell Incorporated; Killark Division.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Robroy Industries.
  - 7. Thomas & Betts Corporation.
  - 8. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
- 1. Material: Sheet metal unless otherwise indicated.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
  1. Listing and Labeling: Paddle fan outlet boxes shall be UL listed and labeled as defined in NFPA 70, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: Minimum 4 inches square by 2-1/8 inches deep.
- L. Gangable boxes are prohibited.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor dry locations and Type 4X stainless steel for outdoor, damp and wet locations. Enclosures shall have continuous-hinge cover with flush latch unless otherwise indicated.
  1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
  1. NEMA 250, Type 1 galvanized-steel box for indoor dry locations and type 4X stainless steel for outdoor, damp and wet locations. Each cabinet shall have removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.

## **2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**

- A. General Requirements for Handholes and Boxes:
  1. Boxes and handholes for use in underground systems shall be designed and identified as defined in CEC, for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Christy Concrete Products.
  2. Oldcastle Precast Group.
  3. Jensen Precast
- C. Comply with ASTM C 858 for design and manufacturing processes.

- D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have traffic load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  4. Cover Legend: Molded lettering, "GWC ELECTRIC." Refer to drawings for additional information.
  5. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
  6. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
    - a. Extension shall provide increased depth of 12 inches.
    - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
  7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
    - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
  8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    - a. Type and size shall match fittings to duct or conduit to be terminated.
    - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
  9. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
  10. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

## **2.07 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## **PART 3 EXECUTION**

### **3.01 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC. Inside concrete walls and columns only.
  - 3. Underground Conduit: Type EPC-40-PVC or Type EPC-80-PVC, direct buried, concrete encased as indicated. All raceways containing medium and high voltage conductors and cables shall be encased in 3000 psi red concrete. Red color shall be factory premixed during manufacture using 1-1/2 lbs of red ocher dye in one sack of cement.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4 X stainless steel.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT. Raceway locations include above suspended ceilings, unfinished dry spaces.
  - 2. Exposed: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Electrical, Mechanical and Elevator Machine rooms.
    - d. Gymnasiums.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 4. Concealed in concrete walls and columns: RNC Type EPC-40-PVC.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: GRC.
  - 7. Boxes and Enclosures: NEMA 250, Type 1 for indoor dry locations , except use NEMA 250, Type 4X stainless steel in kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .

### **3.02 INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with CEC limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Provide separate raceways for normal and emergency power wiring, low, medium and high voltage wiring, communication system wiring, fire detection and alarm system, signal and control system wiring.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions unless otherwise indicated.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from RNC, Type EPC-40-PVC to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 250lbs (113 kgs) tensile strength. Leave at least 12 inches of slack at each end of pull wire. Provide acrylic identification tags (2"X4") at each end indicating the source. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to CEC and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to CEC.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by CEC.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

- a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
  - d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
    1. Use LFMC in damp or wet locations -
  - Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
  - Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
  - AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  - BB. Locate boxes so that cover or plate will not span different building finishes.
  - CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
  - DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
  - EE. Set metal floor boxes level and flush with finished floor surface.
  - FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.03 INSTALLATION OF UNDERGROUND CONDUIT**

- A. Direct-Buried Conduit:
  1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312316.13 "Trenching" for pipe less than 6 inches in nominal diameter.
  2. Install backfill as specified in Section 312323 "Fill"
  3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill

- around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
  6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
  7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### **3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances. Top of conduits inside the handhole/box shall be minimum 4 inches above the bottom of the handhole/box unless otherwise indicated.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel (minimum 6 inch high), graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, Refer to drawings for additional information.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### **3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."



### **3.06 FIRESTOPPING**

- A. Install fire-stopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 " Firestopping."

### **3.07 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**



**SECTION 26 05 43**  
**UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

**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. This Section includes the following:
  - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
  - 2. Handholes and boxes.
  - 3. Manholes.
- B. Related Requirements:
  - 1. Section 260526 "Grounding and Bonding of Electrical Systems".

**1.03 DEFINITION**

- A. RNC: Rigid nonmetallic conduit.
- B. PVC coated GRS: PVC coated Galvanized rigid steel conduit
- C. PVC: Poly Vinyl Chloride
- D. NETA: InterNational Testing Association
- E. UL: Underwriter Laboratories

**1.04 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Duct-bank materials, including separators and miscellaneous components.
  - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Accessories for manholes, handholes, boxes, and other utility structures.
  - 4. Warning tape.
  - 5. Warning planks.
  - 6. Pull ropes.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Reinforcement details.
  - 3. Frame and cover design and manhole frame support rings.

4. Ladder details.
  5. Grounding details.
  6. Cable racks, insert. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
  7. Joint details.
- C. Shop Drawings for Factory-Fabricated Manholes, Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
1. Duct entry provisions, including locations and duct sizes.
  2. Cover design. Include details of factory engraved markings as specified.
  3. Grounding details.
  4. Cable racks, inserts. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Sustainable Design Submittals:
1. Product Data: For adhesives and sealants, indicating VOC content.
  2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
  2. Drawings shall be signed and sealed by a qualified California registered professional electrical engineer.
- B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858. Certificates shall be signed by manufacturer's California registered professional structural engineer. Include name and date.
- C. Qualification Data: For professional engineer and testing agency.
- D. Source quality-control test reports. Certified test reports signed by Factory Engineer indicating, actual test data, analysis of the test results, date and location and of the tests.
- E. Field quality-control test reports.

#### **1.06 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Each conduit shall bear manufacturer's trademark and UL label. Conduits and fittings shall be of a single manufacturer. Multiple manufactures for the same material are not acceptable.
- D. Comply with California Electric Code (CEC).

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Deliver precast concrete manholes, handholes and other underground utility structures when the site is ready for installation. Store precast concrete and other factory-fabricated underground utility structures at Project site (if necessary) as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

### **1.08 PROJECT CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Architect's and Owner's written permission.
  - 3. Existing electrical service shall be shut down by owner's authorized personnel. Coordinate with owner in advance.

### **1.09 COORDINATION**

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Verify existing utilities within the project area using an independent electronic locator service. Pot-hole using vacuum pot holing equipment to find the exact location of existing underground utilities minimum two weeks prior to start of excavation work.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

## **PART 2 PRODUCTS**

### **2.01 CONDUIT**

- A. RNC: Heavy wall design; NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. Make all fittings watertight with solvent-weld recommended by the conduit manufacturer and specifically manufactured for the purpose.

### **2.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube and Conduit
  2. Cantex, Inc.
  3. Lamson & Sessions; Carlon Electrical Products.
  4. JM Eagle
- B. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
  3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
    - a. Color: Red dye added to concrete during batching.
    - b. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

### **2.03 PRECAST CONCRETE HANDHOLES AND BOXES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Christy Concrete Products.
  2. Oldcastle Precast Group.
  3. Jensen Precast
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have traffic load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  4. Cover Legend: Molded lettering, "GWC ELECTRIC." ""
  5. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
  6. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
    - a. Extension shall provide increased depth of 12 inches.
    - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
  7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

- a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
  - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
  - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
- a. Type and size shall match fittings to duct or conduit to be terminated.
  - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
9. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

#### **2.04 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE**

- A. Description: Comply with SCTE 77.
- 1. Color: Gray.
  - 2. Configuration: Units shall be designed for flush burial and have open or closed bottom, as specified.
  - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 5. Cover Legend: Molded lettering, "GWC ELECTRIC."
  - 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
  - 7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  - 8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

#### **2.05 PRECAST MANHOLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Christy Concrete Products.
  - 2. Oldcastle Precast Group.
  - 3. Jensen Precast
- B. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features. Factory fabricated with reinforced concrete.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
  - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
  - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - a. Type and size shall match fittings to duct or conduit to be terminated.
  - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.
- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## **2.06 CAST-IN-PLACE MANHOLES**

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C 858 and with Section 033000 "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

## **2.07 UTILITY STRUCTURE ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Bilco Company (The).
  2. Christy Concrete Products.
  3. Neenah Foundry Company.
  4. Oldcastle Precast Group.
  5. Underground Devices, Inc.
  6. Utility Concrete Products, LLC.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
  1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B 29 inches.
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.



- b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
- 2. Cover Legend: Cast in. Selected to suit system.
  - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
  - b. Legend: "Name of serving utility company"; "ELECTRIC-HV"; "Manhole/Handhole number as indicated on the drawings" for duct systems with medium-voltage cables.
  - c. Legend: "Name of serving utility company"; "SIGNAL"; "Manhole/Handhole number as indicated on the drawings" for communications, data, and telephone duct systems.
- 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
  - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.
  - 1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
  - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
  - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- I. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
  - 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
  - 2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
  - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
  - 1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.
  - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
- K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- L. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

## **2.08 SOURCE QUALITY CONTROL**

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by a independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified California registered professional engineer shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## **PART 3 EXECUTION**

### **3.01 UNDERGROUND DUCT APPLICATION**

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in red concrete-encased duct bank, unless otherwise indicated. Concrete shall be preimixed during manufacture using 1-1/2 lbs of red ocher dye per one sack of cement. Sprinkling red color in the field is not acceptable.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated. Underground ducts in planter areas shall have 6 inches of sand below and 2 inches of lean concrete on the top.
- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

- E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank, unless otherwise indicated.
- F. Underground Ducts Crossing Walks and Driveways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

### **3.02 UNDERGROUND ENCLOSURE APPLICATION**

- A. Handholes and Boxes for 600 V and Less:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Manholes: Precast concrete.
  - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

### **3.03 EARTHWORK**

- A. Excavation and Backfill: do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- D. Cut and patch existing pavement in the path of underground ducts and utility structures

### **3.04 DUCT INSTALLATION**

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated. For underground ducts containing MV and HV cables, use manufactured long sweep bends with a minimum radius 25 feet (7.5 m) both horizontally and vertically. Number of bends on ducts for HV and MV systems, telephone and signal systems shall not exceed two (2) 90 degrees.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

- D. Installation Adjacent to High-temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line. Maintain minimum 12 inch separation unless the calculations require more separation.
- E. Installation Adjacent to Other Utilities: Where ducts are installed parallel to other utilities e.g. communication, sound maintain minimum 12 inches of separation from any ducts containing power feeders, light circuits.
- F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
  - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Building Wall Penetrations: Make a transition from underground duct to pvc coated rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Do not install conduits underneath a building except where the service/feeder/branch circuit conduits enter the building.
- I. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psi hydrostatic pressure.
- J. Pulling Cord: Install minimum 1/8 inch thick ~~100-lb~~ test nylon cord with minimum 250 pounds per foot tensile strength in ducts, including spares.
- K. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion

- fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
- b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
  4. Encase all feeder ducts in a 3 inch concrete envelope. Extend envelope with 3 inches beyond all external surfaces of all outer most ducts. Do not over pour the concrete.
  5. Concrete encasement shall be minimum 3000 psi. All underground ducts containing MV and HV cables (above 600V) shall be encased in red concrete. Concrete shall be premixed during batching with 1-1/2 lbs of red ocher dye per sack of cement.
  6. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  7. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  8. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, and 12 inches (300 mm) between power and signal ducts.
  9. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 36 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated. Minimum depth below grade in all areas shall be 36 inches (900 mm) for underground ducts containing MV and HV ducts.
  10. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
  11. Warning Tape: Bury warning tape approximately 12 inches below grade above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- L. Direct-Buried Duct Banks:
1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms
4. Install backfill
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction
6. Install ducts with a minimum of 3 inches between ducts for like services and 12 inches (300 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
11. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

### **3.05 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES**

- A. Cast-in-Place Manhole Installation:
  1. Finish interior surfaces with a smooth-troweled finish.
  2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
  3. Cast-in-place concrete, formwork, and reinforcement are specified in Section 033000 "Cast-in-Place Concrete."

- B. Precast Concrete Handhole and Manhole Installation:
  - 1. Comply with ASTM C 891, unless otherwise indicated.
  - 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
  - 3. Unless otherwise indicated, support units on a level bed of 12 inches thick crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevations:
  - 1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
  - 2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. In other areas, set manhole frames 1 inch above finished grade.
  - 3. Install handholes with bottom below the frost line, below grade.
  - 4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
  - 5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
  - 1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  - 2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.
- H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

### **3.06 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

- B. Unless otherwise indicated, support units on a level bed of 12 inches thick crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and traffic ways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
  - 1. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: 10 inches wide by 12 inches deep.

### **3.07 GROUNDING**

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

### **3.08 FIELD QUALITY CONTROL**

- A. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed from manhole to vault, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the duct, shall be drawn through each duct, after which a brush having the diameter of the duct, and have stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, gravel and other foreign materials. Conduit plugs shall then be immediately installed. Underground conduits, which terminate inside the building below grade, or which slope so that water might flow into building, shall be sealed at termination after installation of wires.
- B. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.



3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Correct deficiencies and retest as specified above to demonstrate compliance.

### **3.09 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

**END OF SECTION**



## SECTION 26 05 44

### SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

#### 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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 07 84 00 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit EQ 4: For sealants, 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."

#### PART 2 PRODUCTS

##### 2.01 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
  - 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, of length required to secure pressure plates to sealing elements.

## 2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, water stop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers:
    - a. Presealed Systems.

## 2.04 GROUT

- A. Description: Nonshrink; recommended 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.

## **2.05 SILICONE SEALANTS**

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## **PART 3 EXECUTION**

### **3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### **3.02 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.03 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water stop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION**

## SECTION 26 05 48

### VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

#### 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. This Section includes the following:
  - 1. Isolation pads.
  - 2. Spring isolators.
  - 3. Restrained spring isolators.
  - 4. Channel support systems.
  - 5. Restraint cables.
  - 6. Hanger rod stiffeners.
  - 7. Anchorage bushings and washers.

##### 1.03 DEFINITIONS

- A. The CBC: California Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the CBC: D.
  - 2. Assigned Seismic Use Group or Building Category as Defined in the CBC: II.
    - a. Component Importance Factor: 1.0.
    - b. Component Response Modification Factor: Per ASCE 7-05 Table 13.6-1.
    - c. Component Amplification Factor: ASCE7-05 Table 13.6-1.
  - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second):  $S_{ds} = 1.00g$
  - 4. Design Spectral Response Acceleration at 1.0-Second Period:  $S_{1s} = 0.60g$

##### 1.05 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 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 seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
    - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
  2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
  3. Field-fabricated supports.
  4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
    - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

#### **1.06 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Field quality-control test reports.

#### **1.07 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: 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 OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent



testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

- E. Comply with NFPA 70.

## **PART 2 PRODUCTS**

### **2.01 VIBRATION ISOLATORS**

- 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:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by the following:
  - 1. Ace Mountings Co., Inc.
  - 2. Amber/Booth Company, Inc.
  - 3. California Dynamics Corporation.
  - 4. Isolation Technology, Inc.
  - 5. Kinetics Noise Control.
  - 6. Mason Industries.
  - 7. Vibration Eliminator Co., Inc.
  - 8. Vibration Isolation.
  - 9. Vibration Mountings & Controls, Inc.
- D. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
  - 1. Resilient Material: Oil- and water-resistant neoprene.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
  - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
  - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or

- rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
  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.

## 2.02 SEISMIC-RESTRAINT DEVICES

- 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:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by the following:
  1. Amber/Booth Company, Inc.
  2. California Dynamics Corporation.
  3. Cooper B-Line, Inc.; a division of Cooper Industries.
  4. Hilti Inc.
  5. Loos & Co.; Seismic Earthquake Division.
  6. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
  1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support 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; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- H. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

- I. 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.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### **2.03 FACTORY FINISHES**

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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 Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### **3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION**

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.
  - 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 an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. 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.
- C. 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.
- D. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION**

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### **3.05 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. 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.
  9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### **3.06 ADJUSTING**

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

**END OF SECTION**



**SECTION 26 05 53**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**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. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.

**1.03 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's catalog cut sheets for each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

**1.04 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969. Adhesive type labels shall be used for only applications indicated in this section.

**1.05 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 PRODUCTS**

### **2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Feeders and Circuits at 600 V or Less:
  - 1. Black letters on an orange field
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Feeders and Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- G. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

### **2.02 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.



### 2.03 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

### 2.04 CONDUCTOR AND CABLES IDENTIFICATION MATERIALS

- A. Color coding of conductors: Provide color coded insulation by conductor manufacturer. Coordinate with Division 26, Section 26 05 26 "Low Voltage Electrical Power Conductors and Cables". If permitted by owner's representative in writing, install color coding conductor tape for temporary installations only.
- B. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Medium voltage cable tag: Laminated Micrata type, 5" x 3½", nameplates engraved with 5/32-inch high black letters on white background for normal power and red letters on white background for emergency power.
  - 1. Feeder or circuit number.
  - 2. Size of MV cable and equipment grounding conductor.
  - 3. Point of origin and point of destination.

4. Date of installation
  5. Name of installing contractor
- H. Provide tags on each pull rope of spare conduits showing starting point and end point of spare conduits.

## **2.05 FLOOR MARKING TAPE**

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

## **2.06 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
1. Comply with ANSI Z535.1 through ANSI Z535.5.
  2. Inscriptions for Red-Colored Tapes: CAUTION-BURIED ELECTRIC LINE, HIGH VOLTAGE.
  3. Inscriptions for Orange-Colored Tapes: CAUTION-BURIED TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Tag: Type IID :
1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  2. Width: 6 inches
  3. Overall Thickness: 5 mils.
  4. Foil Core Thickness: 0.35 mil.
  5. Weight: 34 lb/1000 sq. ft.
  6. Tensile according to ASTM D 882: 300 lbf and 12,500 psi .

## **2.07 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
  3. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 60 INCHES."
  4. High Voltage Equipment Warning "DANGER - HIGH VOLTAGE - KEEP OUT".
  5. Provide other warning labels and signs as required by applicable code and regulation.

## 2.08 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face. <Insert colors for other applications>.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.09 EQUIPMENT IDENTIFICATION LABELS

- A. Stenciled Legend: Provide stenciled labels to identify major equipment numbers (e.g. transformers, MV switches etc) indicated on drawings, in nonfading, waterproof, black ink or paint. Minimum letter height shall be 2 inch. Verify letter height with Owner's representative prior to start of work. Stencil labels shall be provided in addition to engraved laminated labels specified in para D below.
- B. Labels shall include the following information. Color of nameplate shall be black for equipment connected to normal power, red for equipment connected to emergency power, and blue for equipment connected to Un-interruptible Power Supply. Color of letters shall be white.
1. Panel or equipment designation.
  2. Rating: Volt, Amps, No. of phase and wires, horsepower, etc.
  3. AIC Rating (RMS Symmetrical Amps).
  4. Fed from information.
  5. Manufacturer Shop Order number.
  6. Date of Installation.
  7. Other information as requested by Owner.
- C. For medium-voltage switchgear:

1. Use 1 inch to identify equipment designation
  2. Use 3/4 inch to identify voltage rating and source
  3. Use 1/2 inch to identify individual feeder breakers and buckets
  4. Use 1/4 inch to identify control switches, indicating lights, and other miscellaneous devices on the bucket door.
- D. Adhesive labels and nameplates are not acceptable. Attach labels and nameplates with cadmium plated screws.

## **2.10 WIRING DEVICES LABELS**

- A. Identify wiring devices with heavy duty clear vinyl polyester tape “Weber” unless otherwise indicated. Provide labels on the device cover plate made of non-metallic materials. Color of letters shall be black for device connected to normal power, color of letters shall be red for device connected to emergency power. Labels shall be printed, flexible, self-adhesive type. In addition write the circuit no. (e.g. 1PA-2) on the inside of the device cover plate of non-metallic material using a permanent marker.
- B. For stainless steel cover plates, engrave information on the device cover plate.
- C. Device (receptacles, switches etc.) label shall include panel designation and circuit number.

## **2.11 CABLE TIES**

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F.
  5. Color: Black.

## **2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### **3.02 IDENTIFICATION SCHEDULE**

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
  - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to raceways concealed within wall.
  - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label bands. Install labels at 10-foot maximum intervals.
- D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power
  2. Power
  3. UPS
- E. Power-Circuit Conductor Identification, 600V or less: Provide factory color coded conductors as indicated in Division 26 "Low Voltage Power Conductors and Cables". Color coding tape may be field applied (if specified on the documents or permitted in writing by Owner's representative) to identify phase conductors in vaults, pull and junction boxes, manholes, handholes and other locations where conductors are spliced and terminated. Colors for factory-assembled cable, such as MC and AC, must match colors listed in first paragraph below. .
1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeders and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral : White
      - 5) Ground Green
    - c. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
      - 4) Neutral : Grey
      - 5) Ground : Green
    - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use Laminated Micrata type, 5" x 3½", nameplates engraved with 5/32-inch high black letters on white background for normal power and red letters on white background for emergency power. Include the circuit designation to match owner's existing standard. Verify with owner's representative prior to making labels.
- G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- I. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes self-adhesive vinyl labels with the conductor designation.
- J. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

- K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- L. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
  - 2. During backfilling of trenches install continuous underground-line warning tape directly above the line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- M. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- N. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- O. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- P. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer, load shedding..
- Q. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems. Verify requirements with Owner's representative.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label listed for outdoor application.

- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
  - d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to Be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panel board manufacturer. Panelboard identification shall be engraved laminated acrylic label.
  - b. Enclosures, electrical, telecom, alarm and communication system cabinets.
  - c. Access doors and panels for concealed electrical items.
  - d. Switchgear.
  - e. Switchboards.
  - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panel boards or equipment supplied by the secondary. For pad-mount transformers- indicate type and size of fuses on a separate 3" X 5" plastic laminated label and install on the inside surface of the door of the transformer.
  - g. Substations.
  - h. Emergency power system boxes and enclosures.
  - i. Motor-control centers.
  - j. Enclosed switches including ATS.
  - k. Enclosed circuit breakers.
  - l. Enclosed controllers.
  - m. Push-button stations.
  - n. Power transfer equipment including transfer switches.
  - o. Contactors.
  - p. Remote-controlled switches, dimmer modules, and control devices.
  - q. Power-generating units.
  - r. Monitoring and control equipment.
  - s. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
  - t. Fire detection and alarm panels.
  - u. UPS

**END OF SECTION**



## **SECTION 26 24 13 SWITCHBOARDS**

### **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. Service and distribution switchboards rated 600 V and less and 800A and above.
  - 2. Transient voltage suppression devices (TVSS).
  - 3. Disconnecting and overcurrent protective devices.
  - 4. Instrumentation.
  - 5. Control power.
  - 6. Accessory components and features.
  - 7. Identification.
  - 8. Mimic Bus.
- B. Switchboard shall be front aligned and front accessible.
- C. Related Sections include the following:
  - 1. Section 26 05 26 "Grounding and Bonding For Electrical Systems".
  - 2. Section 26 05 53 "Identification for Electrical Systems".

#### **1.03 DEFINITIONS**

- A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. RFI: Radio-frequency interference.
- E. RMS: Root mean square.
- F. SPDT: Single pole, double throw.
- G. AIC: Interrupting capacity (RMS symmetrical) in amperes.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.05 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details, including required horizontal and vertical clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
  - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
  - 6. Detail utility company's metering provisions with indication of approval by utility company.
  - 7. Include evidence of UL listing for series rating of installed devices. Series rated devices shall not be provided unless specifically indicated on the drawings.
  - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
  - 10. Include diagram and details of proposed mimic bus.
  - 11. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

### 1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Ceiling and floor plans, drawn to scale (1/4"=1'-0"), on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Show structural members e.g columns, beams, doors etc. within the area where switchboards are located.
- B. Qualification Data: For qualified testing and inspection agency.
- C. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
4. Submit within two (2) weeks of completion of tests.

### **1.07 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. include the following:
  1. Routine maintenance requirements for switchboards and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

### **1.08 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two 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 sets of each size and type.
  3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

### **1.09 QUALITY ASSURANCE**

- A. American made products have been acceptable to the Owner. If non-domestic products are submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. Testing shall be done by a recognized lab acceptable to the Owner and all tests shall be witnessed by Owner's personnel. Testing procedures and test results shall be satisfactory to the Owner. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Owner's representative to witness the test at the testing lab. Include all costs for the above in the bid.
- B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Switchboards similar to the type and size specified in this project.
- C. Manufacturer shall have ISO 9001 or 9002 Certification.

- D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.
- E. Switchboards shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.
- F. Switchboard shall comply with seismic zone applicable to the project. Provide certified test reports of shake table test done by manufacturer on similar units.
- G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g., primary switch, transformer, and switchboard) shall be manufactured within six months of installation.
- H. Source Limitations: Obtain switchboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer as the substation.
- I. Comply with NEMA PB 2.
- J. Comply with NFPA 70.
- K. Comply with UL 891.
- L. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- M. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchboards and are based on the specific system indicated. Refer to Part 2 "Product Requirements."
- N. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended location and application.
- O. Testing Agency Qualifications: Member of NETA;
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards and OCPDs similar to those specified on this project.
  - 2. Testing company shall be located with 50 miles radius of the project.
  - 3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
  - 4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switchboards similar to the type and rating specified on this project.
- P. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products in accordance with manufacturer's recommended practices and as listed in Installation and Maintenance Manual.

- B. Each switchboard section shall be shipped in individual shipping splits for ease of handling. They shall be mounted on shipping skids and individually wrapped.
- C. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path at site.
- D. Inspect and report damage to carrier within their required time period.
- E. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- F. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage.
- G. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
- H. Handle and prepare switchboards for installation according to NECA 400.

### 1.11 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
  - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated
    - a. Ambient Temperature: Not exceeding 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than fourteen (14) days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Owner's Representative and Owner's written permission.
  - 3. Comply with NFPA 70E.
  - 4. Provide temporary standby power through a standby diesel quiet type back-up generator complete with fuel and 7/24 monitoring if the existing service interruption exceeds 2 hours. Coordinate additional requirements with owner minimum fourteen days in advance. Indicate method of providing temporary electric service.

## 1.12 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Make sure switchboards shall fit in the available space shown.

## 1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five (5) years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; a brand of Schneider Electric
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 4. Siemens
- B. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: Fixed, individually mounted unless otherwise indicated.
  - 2. Branch Devices: Panel mounted for sizes up to 400A. Individually mounted for sizes above 400A.
  - 3. Sections front and rear aligned.
- C. Nominal System Voltage: 480Y/277 V.
- D. Main-Bus Continuous: 2500 A.
- E. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces.
- F. Indoor Enclosures: Steel, NEMA 250, Type 1.
- G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- H. Barriers: Between adjacent switchboard sections.
- I. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

- J. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. For switchboards with space heaters, provide CTs ahead of the main so that power used by the space heaters is recorded by the meter too.
- K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Pull Box on Top of Switchboard:
  1. Provide a proper size (per NEC) pull box on the top of the switchboard.
  2. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
  3. Set back from front to clear circuit-breaker removal mechanism.
  4. Removable covers shall form top, front, and sides. Top covers at front/sides shall be easily removable for drilling and cutting.
  5. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
  6. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- N. Buses and Connections: Three phase, four wire unless otherwise indicated.
  1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, copper feeder circuit-breaker line connections.
  2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
  3. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
  4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
  5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- P. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

## **2.02 SURGE PROTECTION DEVICES (SPDs): UL listed and labeled and complying with UL 1449.**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; a brand of Schneider Electric.
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. Or equal.
- B. SPDs with the following features and accessories:
  - 1. Integral disconnect switch.
  - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
  - 3. Indicator light display for protection status.
  - 4. Form-C contacts rated at 5 A and 250-V ac one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system. Audible alarm activated on failure of any surge diversion mode.
  - 5. Surge counter. Six digit transient counter set to total transient surge that deviate from the sine-wave envelope by more than 125V.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V (as indicated on drawings), three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 1200 V for 480Y/277 V; 1200 V for 208Y/120 V.
  - 2. Line to Ground: 1200 V for 480Y/277 V; 1200 V for 208Y/120 V.
  - 3. Line to Line: 2000V for 480/277V.

## **2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Series ratings are not acceptable. Refer to drawings for additional information.
  - 1. Thermal-Magnetic Circuit Breakers for below 400A frame size: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic trip circuit breakers with rms sensing for circuit breakers 400A frame and above; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long and short time adjustments.
    - d. Ground-fault pickup level, time delay, and I<sub>2</sub>t response.
  - 4. MCCB Features and Accessories:



- a. Standard frame sizes, trip ratings, and number of poles as indicated on drawings. Provide shunt trip on circuit breakers indicated on single line diagram.
- b. Lugs: Mechanical style, suitable for number, size, trip ratings and conductor material.
- c. Application Listing: Appropriate for application; type SWD for switching fluorescent lighting loads, type HID for feeding fluorescent and high intensity discharge (HID) lighting circuits.
- d. Ground Fault Protection: Comply with UL 1053. Integrally mounted relay with internal memory, and three phase current transformer/sensor. and trip with field adjustable pick-up and time delay settings, push to test feature and ground fault indicator. No trip relay test permits ground fault simulation test without tripping.
- e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage. Verify setting with Protective Device Coordination Study.
- g. Under-voltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
- h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
- i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

## 2.04 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
  - 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound-type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
  - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Megawatts: Plus or minus 2 percent.

- e. Megavars: Plus or minus 2 percent.
  - f. Power Factor: Plus or minus 2 percent.
  - g. Frequency: Plus or minus 0.5 percent.
  - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
  - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
  - j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
  3. Digital Meter shall be manufactured by the one following manufacturers: Square D; Eaton-Cutler Hammer, or Shark.

## **2.05 ACCESSORY COMPONENTS AND FEATURES**

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

## **2.06 IDENTIFICATION**

- A. Service Equipment Label: UL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Examine switchboards before installation to verify compliance with approved shop drawings. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected to the satisfaction of the owner.

## **3.02 INSTALLATION**

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "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 switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
  - D. Comply with mounting and anchoring requirements.
  - E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
  - F. Install filler plates in unused spaces of panel-mounted sections.
  - G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
    1. Set field-adjustable switches and circuit-breaker trip ranges in accordance with the recommendations of the Overcurrent Protective Device Short Circuit, Coordination and Arc Flash Study.
  - H. Comply with NECA 1.

### **3.03 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting, and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### **3.04 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- 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, start-up and to assist in testing.
- C. Acceptance Testing Preparation:
  1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. All tests shall be witnessed by owner's representative. Provide minimum fourteen (14) days advance notice.
  3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  4. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Switchboard will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.05 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges

### **3.06 PROTECTION**

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

### **3.07 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

**END OF SECTION**

**SECTION 26 24 16**  
**PANELBOARDS**

**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. Distribution panelboards (Rated 600A and below).
  - 2. Lighting and appliance branch-circuit panelboards.
- B. Related Sections include the following:
  - 1. Section 26 05 53 "Identification for Electrical Systems".

**1.03 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RMS: Root mean square.
- D. SPDT: Single pole, double throw

**1.04 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest California Building Code (CBC) with DSA Amendments.

**1.05 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of UL listing for series rating of installed devices. Series rated devices shall not be permitted unless specifically indicated on the drawings.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

#### **1.06 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing and inspection agency.
- B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces. Include the following:
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Quality-Control Reports:
  1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
  4. Submit within two (2) weeks of completion of tests.
- D. Panelboard Schedules: For installation in panelboards.

#### **1.07 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### **1.08 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

## 1.09 QUALITY ASSURANCE

- A. American made products have been acceptable to the Owner. If non-domestic products are submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. Testing shall be done by a recognized lab acceptable to the Owner and all tests shall be witnessed by Owner's personnel. Testing procedures and test results shall be satisfactory to the Owner. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Owner's representative to witness the test at the testing lab. Include all costs for the above in the bid.
- B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Panelboards similar to the type and size specified in this project.
- C. Manufacturer shall have ISO 9001 or 9002 Certification.
- D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.
- E. Panelboards shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.
- F. Panelboard shall comply with seismic zone applicable to the project. Provide certified test reports of shake table test done by manufacturer on similar units.
- G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g., circuit breakers) shall be manufactured within six months of installation.
- H. Source Limitations: Obtain panelboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer as the substation.
- I. Comply with NFPA 70.
- J. Comply with NEMA PB 1.
- K. Comply with UL 891.
- L. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- M. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Part 2 "Product Requirements."
- N. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended location and application.
- O. Testing and Inspection Agency Qualifications: Member of NETA;
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards, panelboards and OCPDs similar to those specified on this project.
  - 2. Testing company shall be located with 50 miles radius of the project.

3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switchboards similar to the type and rating specified on this project.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

#### **1.11 PROJECT CONDITIONS**

- A. Environmental Limitations:
  1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of electric service.
  2. Do not proceed with interruption of electric service without Architect and Owner's written permission.
  3. Comply with NFPA 70E.

#### **1.12 COORDINATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.



### 1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.
- B. Enclosures: Flush- and surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 4. Finishes:
    - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat
    - b. Back Boxes: Galvanized steel.
  - 5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom based on installation location.
- D. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated copper.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  - 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
  - 5. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated copper.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: UL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard shall be listed and labeled with UL short circuit rating, Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Verify available fault levels from the short circuit study.

## **2.02 DISTRIBUTION PANELBOARDS (Maximum Rating 600A)**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. Square D; a brand of Schneider Electric
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 4. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Interiors shall be completely factory assembled. These shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus interiors.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- E. Mains: Circuit breaker or Lugs only. See panel schedules on drawings for requirements. Circuit breakers 400AF and above shall be microprocessor type with electronic trip; with field replaceable rating plug and field adjustable following settings:
  - 1. Instantaneous trip
  - 2. Long and short time pick up levels
  - 3. Long and short time adjustments
  - 4. Ground fault pick up level, time delay and I<sup>2</sup>t response.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- H. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
- I. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard. Refer to drawings for additional information.
  - 1. Internal Control-Power Source: Factory installed control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

### **2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. Square D; a brand of Schneider Electric
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 4. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only. Review panel schedules for requirements.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door type. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

### **2.04 ACCESSORY COMPONENTS AND FEATURES**

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install panelboards and accessories according to NECA 407.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "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 full perimeter of base.
  - 2. For panelboards, 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 panelboards.
  5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
  - D. Comply with mounting and anchoring requirements.
  - E. Mount top of trim 90 inches maximum above finished floor unless otherwise indicated. Mounting height of Over Current Protective Devices shall be 6"6" above finished floor (including height of house keeping pad) to the center of the grip of device operating handle unless a lower height is indicated or required by code.
  - F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
  - G. Install overcurrent protective devices and controllers not already factory installed.
    1. Set field-adjustable, circuit-breaker trip ranges.
  - H. Install filler plates in unused spaces.
  - I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
  - J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
  - K. Comply with NECA 1.

### **3.03 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### **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.
- B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in latest standard of NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include color scanned photos, notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.05 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  1. Measure as directed during period of normal system loading.
  2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### **3.06 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION**

**SECTION 26 27 26**  
**WIRING DEVICES**

**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. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Twist-locking receptacles.
  - 3. Receptacles with integral surge-suppression units.
  - 4. Isolated-ground receptacles.
  - 5. Tamper-resistant receptacles.
  - 6. Weather-resistant receptacles.
  - 7. Snap switches and wall-box dimmers.
  - 8. Solid-state fan speed controls.
  - 9. Wall-switch and exterior occupancy sensors.
  - 10. Communications outlets.
  - 11. Pendant cord-connector devices.
  - 12. Cord and plug sets.
  - 13. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

**1.03 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.

**1.05 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

### **1.06 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

### **1.07 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### **1.08 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Switches, receptacles and cover plates shall be of the same manufacturer.
- B. Comply with National Electrical Manufacturer's Association (NEMA) standards. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.
- C. Manufacturer shall have a minimum of ten (10) years' experience in the production of wiring devices specified and shall have ISO 9001 and 9002 certifications.
- D. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 2. Leviton Mfg. Company Inc. (Leviton).
  - 3. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

### **2.02 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: UL Listed and labeled and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

### **2.03 STRAIGHT-BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Products: Subject to compliance with requirements, provide one of the following manufacturers:



- a. Hubbell; HBL5361 (single), HBL5362 (duplex).
    - b. Leviton; 5361 (single), 5362 (duplex).
    - c. Pass & Seymour; 5361 (single), 5362 (duplex).
  - 2. Description: Grounded, industrial extra heavy duty specifications grade, back- and side-wired, single-piece grounding brass strap with integral ground, impact-resistant thermoplastic nylon cover and body, smooth face, with separate grounding screw and NEMA 5-20R plug configurations.
- B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
- 1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
    - a. Hubbell; HBL8300SGA.
    - b. Leviton; 8300-SGG.
    - c. Pass & Seymour; TR63H.
  - 2. Description: Grounded, specifications grade, back- and side-wired, single-piece grounding brass strap with integral ground, impact-resistant thermoplastic nylon cover and body, smooth face, with separate grounding screw and NEMA 5-20R plug configurations.
  - 3. Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

#### **2.04 GFCI RECEPTACLES**

- A. General Description:
- 1. Straight blade, feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
  - 4. Include self-test feature so that the outlet is automatically tested every fifteen minutes.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
- 1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
    - a. Hubbell; GFR5352L.
    - b. Pass & Seymour; 2095.
    - c. Leviton; 7590.

#### **2.05 TWIST-LOCKING RECEPTACLES**

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
- 1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
    - a. Hubbell; HBL2310.
    - b. Leviton; 2310.
    - c. Pass & Seymour; L520-R.

#### **2.06 PENDANT CORD-CONNECTOR DEVICES**

- A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## 2.07 CORD AND PLUG SETS

- A. Description:
  1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
  3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.08 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
  1. Products: Subject to compliance with requirements,
    - a. Single Pole:
    - b. Hubbell; HBL1221.
    - c. Leviton; 1221-2.
    - d. Pass & Seymour; CSB20AC1.
- C. Pilot-Light Switches, 20 A:
  1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
    - a. Hubbell; HBL1201PL for 120 and 277 V.
    - b. Leviton; 1221-LH1.
    - c. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
  2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."
- D. Key-Operated Switches, 120/277 V, 20 A:
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Hubbell; HBL1221L.
    - b. Leviton; 1221-2L.
    - c. Pass & Seymour; PS20AC1-L.
  2. Description: Single pole, with factory-supplied key in lieu of switch handle.

## 2.09 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
  3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## **2.10 FLOOR SERVICE FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Hubbell Inc.
  2. Wiremold/Legrand.
- B. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- C. Compartments: Barrier separates power from voice and data communication cabling.
- D. Service Plate: Rectangular, with satin finish.
- E. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- F. Voice and Data Communication Outlet: See IT and AV documents and specifications for requirements.

## **2.11 POKE-THROUGH ASSEMBLIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Hubbell Incorporated; Wiring Device-Kellems.
  2. Wiremold/Legrand.
- B. Description:
  1. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
  2. Comply with UL 514 scrub water exclusion requirements.
  3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for RJ-45 jacks
  4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
  5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
  7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and four-pair cables

## **2.12 FINISHES**

- A. Device Color:
  1. Wiring Devices Connected to Normal Power System: Color shall be selected by Architect from manufacturer's standard colors unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red.
- B. Wall Plate Color: For plastic covers, match device color unless otherwise indicated.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pig-tailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.
  - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
  2. Install hospital-grade receptacles in patient-care areas with the ground pin at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### **3.02 GFCI RECEPTACLES**

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### **3.03 IDENTIFICATION**

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  2. Test Instruments: Use instruments that comply with UL 1436.
  3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

**END OF SECTION**

## SECTION 26 28 13

### FUSES

#### 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. Cartridge fuses rated 600-V ac and less for use in enclosed switches.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
  - 5. Coordination charts and tables and related data.
  - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

##### 1.04 INFORMATION SUBMITTALS

- A. Qualification Data: For qualified testing and inspection agency.
- B. Source Quality-Control Reports: Certified test reports shall be signed by manufacturer's testing engineer and include date of manufacture, actual test data, analysis of the tests, name of the testing engineer, location and date of test. Submit with action submittals.

##### 1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. Include the following:
  - 1. Ambient temperature adjustment information.
  - 2. Current-limitation curves for fuses with current-limiting characteristics.
  - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

#### **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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

#### **1.07 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Manufacturer shall have ISO 9001 or 9002 Certification.
- C. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.
- D. Materials shall be new, modern in design and shall not have been in prior service except as required by factory tests. Fuses shall be manufactured within six months of installation.
- E. 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.
- F. Comply with NEMA FU 1 for cartridge fuses.
- G. Comply with CEC
- H. Comply with UL 248-11 for plug fuses.

#### **1.08 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### **1.09 COORDINATION**

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Bussmann, Inc.
  2. Edison Fuse, Inc.
  3. Ferraz Shawmut, Inc.
  4. Littelfuse, Inc.

#### **2.02 CARTRIDGE FUSES**



- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

### **2.03 PLUG FUSES**

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

### **2.04 PLUG-FUSE ADAPTERS**

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuse holders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 FUSE APPLICATIONS**

- A. Cartridge Fuses:
  - 1. Motor Branch Circuits: Class RK1, time delay.
  - 2. Other Branch Circuits: Class RK1, time delay.
  - 3. Control Circuits: Class CC, fast acting.

### **3.03 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

### **3.04 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION**



**SECTION 26 28 16**  
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Receptacle switches.
  - 4. Shunt trip switches.
  - 5. Molded-case circuit breakers (MCCBs).
  - 6. Molded-case switches.
  - 7. Enclosures.

**1.03 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. NEMA: National Electrical Manufacturers Association
- D. NETA: InterNational Electrical Testing Association.
- E. OCPD: Over Current Protective Device
- F. SPDT: Single pole, double throw.
- G. UL: Underwriter Laboratories.

**1.04 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

**1.05 ACTION SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of UL listing for series rating of installed devices if such devices are specified.
  5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
  7. Include ISO certification.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring. Differentiate between manufacturer installed and field installed wiring.

### **1.06 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Manufacturer's field service report.

### **1.07 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

### **1.08 QUALITY ASSURANCE**

- A. American made products have been acceptable to the Owner. If non-domestic products are submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. Testing shall be done by a recognized lab acceptable to the

Owner and all tests shall be witnessed by Owner's personnel. Testing procedures and test results shall be satisfactory to the Owner. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one Owner's representative to witness the test at the testing lab. Include all costs for the above in the bid.

- B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of switches and circuit breakers similar to the type and size specified in this project.
- C. Manufacturer shall have ISO 9001 Certification.
- D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.
- E. Switches and circuit breakers shall be assembled at the manufacturer's own manufacturing facility using its own major components (e.g., trip units) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.
- F. Provide certified test reports of shake table test done by manufacturer on similar units.
- G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Switches and circuit breakers shall be manufactured within six months of installation.
- H. Source Limitations: Obtain Switches, circuit breakers, overcurrent protective devices, components, and accessories, within same product category, through one source from a single manufacturer through a local distributor unless otherwise noted. All power distribution equipment shall be of the same manufacturer.
- I. Comply with NFPA 70.
- J. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- K. Product Options: Drawings indicate size, profiles, and dimensional requirements of switches and circuit breakers and are based on the specific system indicated. Refer to Part 2 "Product Requirements."
- L. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended location and application.
- M. Testing Agency Qualifications: Member of NETA;
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of OCPDs, switches and breakers similar to those specified on this project.
  - 2. Testing company shall be located with 50 miles radius of the project.
  - 3. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
  - 4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switches and circuit breakers similar to the type and rating specified on this project.

- N. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switches and circuit breakers including minimum clearances between adjacent surfaces and other items. Comply with indicated maximum dimensions.

### **1.09 PROJECT CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner's Representative and Owner no fewer than fourteen (14) days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's Representative and Owner's written permission.
  - 4. Comply with NFPA 70E.

### **1.10 COORDINATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## **PART 2 PRODUCTS**

### **2.01 FUSIBLE SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. Square D; a brand of Schneider Electric
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 4. Siemens Energy & Automation, Inc.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. HD Switches shall be suitable for systems capable of 200 kA at 480 V with Class J, L, R, or T fusing as indicated for single-throw switches; 100 kA at 600 V for double-throw switches.
- D. Switches shall be padlockable in open or closed position based on application requirements indicated on the drawings.
- E. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.
4. Service-Rated Switches: Labeled for use as service equipment.

## **2.02 NONFUSIBLE SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Square D; a brand of Schneider Electric
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  4. Siemens Energy & Automation, Inc.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Factory installed internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Lugs: Mechanical type, suitable for number, size, and conductor material.

## **2.03 SHUNT TRIP SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Cooper Bussmann, Inc.
  2. Ferraz Shawmut, Inc.
  3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
  1. Oil-tight key switch for key-to-test function.
  2. Oil-tight red ON pilot light.
  3. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  4. Form C alarm contacts that change state when switch is tripped.

5. Three-pole, double-throw, fire-safety and alarm relay; verify coil voltage.
6. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

#### **2.04 MOLDED-CASE CIRCUIT BREAKERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Square D; a brand of Schneider Electric
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  4. Siemens Energy & Automation, Inc.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, fully rated with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and below.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Provide for 400A frame size and above. Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  1. Instantaneous trip.
  2. Long- and short-time pickup levels.
  3. Long- and short-time time adjustments.
  4. Ground-fault pickup level, time delay, and  $I^2t$  response. Provide per CEC requirement.
- F. Features and Accessories:
  1. Standard frame sizes, trip ratings, and number of poles.
  2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits. Type HACR for Heating, Air Conditioning and Refrigeration loads.
  4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

#### **2.05 ENCLOSURES**

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 4X Stainless Steel.
  3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X Stainless Steel.
  4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.



## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Maximum height above finished floor to the center of the grip of device operating handle in its highest position shall be 6'-6" unless lower height is required by code including housekeeping pad.
- B. Comply with mounting and anchoring requirements.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

### **3.03 IDENTIFICATION**

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### **3.04 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified independent testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in latest NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection report, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include color scan pictures, notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.05 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges

**END OF SECTION**

**SECTION 31 23 16.13**  
**TRENCHING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Backfilling and compacting for utilities from 5 FEET outside the building to connection point on-site, where indicated on Drawings.

**1.02 RELATED REQUIREMENTS**

- A. 00 31 00 - Available Project Information: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 41 00 - Regulatory Requirements: Code Compliance.
- C. Section 31 23 23 - Fill: Backfilling at building and foundations.

**1.03 DEFINITIONS**

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

**1.04 REFERENCES**

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop; 2018.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012, with Editorial Revision (2015).
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012, with Editorial Revision (2015).
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2017.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Comply with the requirements listed in Section 31 23 23 - Fill.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

## 1.06 COORDINATION OF SPECIFICATION REQUIREMENTS

- A. Coordinate these Specification Section requirements with specifications included on Drawings. Comply with more stringent requirements and with those requirements of the authorities having jurisdiction.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where designated.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.

## PART 2 PRODUCTS

### 2.01 FILL MATERIALS

- A. For fill materials see Section 31 23 23 - Fill.
- B. For bed materials see Section 31 23 23 - Fill.
- C. General Fill: Subsoil excavated on-site.
- D. Structural Fill: Subsoil excavated on-site.
  - 1. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- E. Concrete for Fill: Lean concrete.
- F. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
  - 1. Graded in accordance with ASTM C136/C136M, within the following limits:
    - a. 3/4 inch sieve: 95 to 100 percent passing.
- G. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
  - 1. Grade in accordance with ASTM D2487 Group Symbol GM.
- H. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
  - 1. Grade in accordance with ASTM D2487 Group Symbol SW.
- I. Topsoil: Topsoil excavated on-site.
  - 1. Select.
  - 2. Graded.
  - 3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
  - 4. Acidity range (pH) of 5.5 to 7.5.
  - 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
  - 6. Conforming to ASTM D2487 Group Symbol OH.

## **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

### **3.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Protect plants, lawns, rock outcroppings, and other features to remain.
- E. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect.

### **3.03 TRENCHING**

- A. Excavate subsoil required for conduits, storm drain, sanitary sewer, water and gas piping to municipal utilities.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Trenches Parallel to Footings: Do not place the trench below a 1 vertical to 2 horizontal from 9 inches above the bottom edge of the footing and no closer than 18 inches from the face of footing. CBC Section 1809A.14.
- E. Do not interfere with 45 degree bearing splay of foundations.
- F. Cut trenches wide enough to allow inspection of installed utilities.
- G. Hand trim excavations. Remove loose matter.
  - 1. Hand trim for bell and spigot pipe joints.
- H. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Remove excess excavated material from site.

- K. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- L. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

### **3.04 PREPARATION FOR UTILITY PLACEMENT**

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.
- D. Support pipe and conduit during placement and compaction of bedding fill.

### **3.05 BACKFILLING**

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage installed piping and conduits, or other work.
- D. Systematically fill and compact as as to achieve 90 percent relative compaction without damaging conduit or pipe. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth or as directed by the Geotechnical Report.
- H. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
  - 1. Thrust bearing surfaces: Fill with concrete.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 or 95 percent of maximum dry density as applicable for the fill area.
- J. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving and similar construction: 95 percent of maximum dry density.
  - 2. At other locations: 90 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.

### **3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS**

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping, Conduits, and Duct Bank:

1. Bedding: Use Fill Type SP or SW (ASTM D2487) or SM with sand equivalent of 30 or greater per ASTM D2419, 3 inches thick, compacted to 90 percent..
2. Cover with Fill Type SP, SW, SM, GM per ASTM D2487.
3. Fill up to subgrade elevation.
4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
5. Gas Piping: As required by the Gas Company.

### **3.07 TOLERANCES**

- A. Top Surface of General Backfilling: Plus or minus 1.2 inch from required elevations.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1.2 inch from required elevations.

### **3.08 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Control, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556 or ASTM D6938.
- C. See Section 31 23 23 for compaction density testing.
- D. Correct unauthorized excavation at no cost to District.
- E. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- F. If tests indicate work does not meet specified requirements, remove work, replace and retest at no additional cost to District.
- G. Correct areas over excavated by error in accordance with Section 31 23 23 - Fill.

### **3.09 CLEANING**

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

### **3.10 PROTECTION OF FINISHED WORK**

- A. Protect finished Work under provisions of Section 01 50 00 - Temporary Construction Facilities and Controls.
- B. Recompect fills subjected to vehicular traffic.

**END OF SECTION**





## SECTION 31 23 23

### FILL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

##### 1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

##### 1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop; 2018.
- B. ACI 302.2R - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials; 2006.
- C. ASTM D4829 - Standard Test Method for Expansion Index of Soils; 2011.
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012, with Editorial Revision (2015).
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. DTSC-Clean Fill - California Department of Toxic Substances Control - Clean Imported Fill Material; Current.
- H. Greenbook - Greenbook: Standard Specifications for Public Works Construction; latest adopted edition.

##### 1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Soil Samples: 10 pounds sample of each type of fill; submit in air-tight containers to testing laboratory.
  - 1. Submit samples directly to Geotechnical Engineer for testing and analysis copy transmittals to Architect and District.

- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.
- E. Compaction Density Test Reports.
- F. Manufacturer's Instructions.
- G. Manufacturer's Qualification Statement.
- H. Specimen Warranty.
- I. Provide proof that all imported materials conform to the requirements of DTSC-Clean Fill Imported Fill Materials for School Sites by proper documentation for the imported materials.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where agreed to.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.

#### **1.08 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 FILL MATERIALS**

- A. General Fill: Subsoil excavated on-site.
  - 1. Graded.
  - 2. Free of lumps larger than 3 inches, rocks larger than 4 inches, and debris.
  - 3. Conforming to ASTM D2487 Group Symbol SP, SW, SM, or GM.
- B. Structural Fill: Subsoil excavated on-site.
  - 1. Graded.

2. Free of organic matter, debris, and oversize particles (e.g., cobbles, rubble, etc. that are larger than 3 inches, rocks larger than 4 inches. Fill shall contain at least fifty percent of material smaller than 1/4 inch in size.
3. Imported fill materials: The soil shall be tested for potential contamination in accordance with DTSC-Clean Fill protocols. Submit to Geotechnical Engineer.
  - a. Import sandy soil shall be free of organics, debris and oversize particles (e.g., cobbles, rubble, etc. that are greater than 3 inches in the largest dimension).
  - b. Additionally, import soils shall not have any corrosion impacts to buried concrete; and be non-expansive (Expansion Index less than 50 per ASTM D4829).
  - c. Prior to import, geotechnical consultant shall evaluate and test the import soils in order to confirm the quality of the material.
4. On-site soils should only be used as specified in the Soils Report.
5. Conforming to ASTM D2487 Group Symbol SP, SW, SM, or GM.
- C. Concrete for Fill: As specified in Section 03 30 00; compressive strength of 2500 psi.
  1. Exception: Concrete used under footings and foundations to correct over-excavation shall be same as for footings and foundation.
- D. Granular Fill - Fill Type GM, GW: Coarse aggregate, conforming to Uniform Standard Specifications for Public Works Construction Off-Site Improvements standard.
- E. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
  1. Grade in accordance with ASTM D2487 Group Symbol GM.
- F. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter.
  1. Grade in accordance with ASTM D2487 Group Symbol SP or SW.
- G. Topsoil: Topsoil excavated on-site.
  1. Unclassified.
    - a. The soil shall be tested for potential contamination in accordance with DTSC-Clean Fill protocols.
  2. Graded.
  3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
  4. Acidity range (pH) of 5.5 to 7.5.
  5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
  6. Conforming to ASTM D2487 Group Symbol OH.
  7. Limit decaying matter to 5 percent of total content by volume.
- H. Type F - Subsoil: Reused, free of rocks larger than 3 inch size, and debris.
  1. Existing fill and alluvium or older alluvium may be considered suitable for re-use as compacted fills provided the recommendations of the geotechnical report and observations of the geotechnical engineer are followed.
  2. Expansive soils (EI>51) are not be placed with the upper 3 feet of subgrade soils

## **2.02 ACCESSORIES**

- A. Geotextile Fabric: Non-biodegradable, non-woven; Geotex 801 manufactured by Propex Geotextile Systems, geotextile.com.

## **2.03 SOURCE QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.
- E. Comply with EPA/DTSC-Clean Fill requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify structural or other backfill materials to be reused or imported are acceptable to the satisfaction of the Geotechnical Engineer. Approval shall be obtained in advance of re-use or importation onto the site.
  - 1. The soil shall be tested for potential contamination in accordance with DTSC-Clean Fill protocols.
  - 2. Provide imported fill materials compatible with on-site soils in addition to being suitable for its intended use with the following criterion, as allowed by the Geotechnical Engineer.
    - a. Predominantly granular in nature.
    - b. Containing no rocks larger than 6 inch maximum dimension.
    - c. Free of organic material (loss on ignition less-than 2 percent).
    - d. Very low expansion potential (with an Expansion Index less than 21).
    - e. Low corrosion impact to the proposed improvements.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.
- C. Identify required lines, levels, contours, and datum locations.
- D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- E. Verify structural ability of unsupported walls to support imposed loads by the fill.
- F. Verify areas to be filled are not compromised with surface or ground water.

### **3.02 PREPARATION**

- A. Scarify and proof roll subgrade surface to a depth of 8 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Greenbook, Type II or concrete fill and compact to density equal to or greater than requirements for subsequent backfill material.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

- D. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95 percent of its maximum dry density in accordance with 1.
- E. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

### 3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
  - 1. Place fill soils compacted in horizontal lifts to a relative compaction of 90 percent or more in general accordance with 1.
  - 2. Lift thickness for fill soils will vary depending on the type of compaction equipment used but should generally be placed in horizontal lifts not exceeding 8 inches in loose thickness.
  - 3. Place fill soils at slightly above optimum moisture content as evaluated by 1.
  - 4. Avoid damage to wet and dry utility lines when compacting fill and subgrade materials.
- C. Employ a placement method that does not disturb or damage other work.
  - 1. Do not disturb or damage foundation perimeter drainage and foundation waterproofing and protective cover utilities in trenches.
- D. Systematically fill and compact per geotechnical report. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
  - 1. Expansive soils (EI>20) are not be placed with the upper 3 feet of subgrade soils. CBC Section 1803.5.3.
- H. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
  - 1. Load-bearing foundation surfaces: Fill with concrete.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 90 or 95 percent of maximum dry density in subgrade zone.
- J. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving, slabs-on-grade, and similar construction: 90 percent of maximum dry density.
  - 2. At other locations: 90 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.
- L. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed

unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

M. Remove surplus fill and backfill materials from site.

### **3.04 FILL AT SPECIFIC LOCATIONS**

A. Use general fill unless otherwise specified or indicated.

B. Structural Fill:

1. Use general fill.
2. Fill up to subgrade elevations.
3. Maximum depth per lift: 6 inches, compacted.
4. Compact to minimum 90 percent of maximum dry density.

C. Under Interior Slabs-On-Grade:

1. Comply with CALGreen Section 4.505.2.1 Capillary Break and ACI 302.2R
2. Use granular fill. Type Class 2 Aggregate base or No. 8 or No. 89, 1/2 inch or larger.
3. Depth: 4 inches deep.
4. Compact to 90 percent of maximum dry density.

D. At Footings:

1. Use general fill.
2. Fill up to subgrade elevation.
3. Compact each lift to 90 percent of maximum dry density.
4. Do not backfill against unsupported foundation walls.
5. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

E. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:

1. Drainage fill and geotextile fabric
2. Cover drainage fill with general fill.
3. Fill up to subgrade elevation.
4. Compact to 90 percent of maximum dry density.

F. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:

1. Bedding: Use general fill.
2. Cover with general fill.
3. Fill up to subgrade elevation.
4. Compact in maximum 8 inch lifts to 90 percent of maximum dry density. Compact to 95 percent in subgrade zone.

G. At Planting Areas Other Than Lawns :

1. Use general fill.
2. Fill up to finish grade elevations.

3. Compact to 90 percent of maximum dry density.
  4. See Section 31 22 00 for topsoil placement.
- H. Under Monolithic Paving :
1. Compact subsoil to 90 percent of its maximum dry density before placing fill.
  2. Use general fill.
  3. Fill up to subgrade elevation.
  4. Compact to 90 percent of maximum dry density.

### 3.05 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch from required elevations.

### 3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
  1. Laboratory Tests and Analyses: Where backfill is required to be compacted to a specified density, tests for compliance shall be made in accordance with requirements specified in Section 01 40 00 - Quality Requirements.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556 or ASTM D6938.
  1. Field inspections and testing shall be performed and submitted in accordance with requirements specified in Section 01 40 00 - Quality Requirements.
  2. Allow testing service to inspect and approve each subgrade and fill layer before further fill, backfill or construction Work is performed.
  3. Alternate Density Test Method:
    - a. Field density tests may also be performed by the nuclear method in accordance with 2, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using 1.
    - b. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with 2.
    - c. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of Work, on each different type of material encountered, and at intervals as directed by Architect or District's testing and inspection agency.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 1557 ("modified Proctor") or AASHTO T 180.
- D. Non-compliance: If tests indicate work does not meet specified requirements, remove work, replace and retest.
  1. Should tests of fill or backfill indicate non-compliance with required density, Contractor shall over-excavate, recompact and retest until specified density is obtained.

2. Costs and Time associated with remedial Work and retesting shall be in accordance with provisions of the General Conditions.
  3. Retesting to demonstrate compliance shall be by a testing laboratory acceptable to District and shall be at Contractor's expense.
- E. Frequency of Tests:
1. Footing Subgrade Testing:
    - a. For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities.
    - b. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Geotechnical Engineer.
  2. Paved Areas and Building Slab Subgrade Testing:
    - a. Perform at least one field density test of subgrade for every 2,000 sf of paved area or building slab, but in no case fewer than three tests.
    - b. In each compacted fill layer, perform one field density test for every 2,000 sf of overlying building slab or paved area, but in no case fewer than three tests.
  3. Foundation Wall Backfill Testing: Perform at least two field density tests at locations and elevations as directed.
- F. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

### **3.07 CLEANING**

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

**END OF SECTION**



**SECTION 32 12 16**  
**ASPHALT PAVING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single course bituminous concrete paving.
- B. Double course bituminous concrete paving.
- C. Surface sealer.
- D. This section compliments and shall be coordinated with Civil Drawing specifications / requirements. The most stringent requirements shall be utilized.
- E. Asphaltic concrete paving for vehicular traffic and curbs, including necessary patching and repair of damaged new and existing paving.
- F. Patching and repair of existing asphaltic concrete paving for previous damage, for underground utility work and where damaged by new construction.

**1.02 RELATED REQUIREMENTS**

- A. Section 32 13 13 - Concrete Paving: Concrete curbs.
- B. Section 32 17 23.13 - Painted Pavement Markings
  - 1. Parking and Traffic Control Pavement Markings.

**1.03 REFERENCE STANDARDS**

- A. AI MS-2 - Asphalt Mix Design Methods; 2015.
- B. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
- D. California Building Code, 2016 Chapter 11B.
- E. SSPWC - Greenbook: Standard Specifications for Public Works Construction; latest adopted edition.

**1.04 SUBMITTALS**

- A. Materials List: List source and quality standard for all asphaltic concrete materials.
- B. Mix Design:
  - 1. Formulate a job-mix formula using the Hveem method in accordance with SSPWC Section 203-6.2 and submit for approval.
  - 2. Submit designs for asphaltic concrete prepared by a materials laboratory under direct supervision of a Civil Engineer licensed in the State of California or a standard mix design proven in actual performance.
  - 3. Resultant Mixture: Hveem properties conforming to SSPWC Section 203-6.4.3.
- C. Certifications:

1. Weighmaster's Certificates or certified delivery tickets for each truckload of bituminous material delivered to site.
  2. Certificates of Conformance: Asphalt, aggregate and sterilant materials.
    - a. 20 days prior to the delivery of aggregates, asphalt materials, and paving mixes to the project site, submit certificates and test results of compliance of such materials with these specifications.
    - b. Submit certificates of compliance from the supplier for bituminous materials for paint binder, asphaltic concrete, and seal coat.
    - c. Submit weigh master's certificates or certified delivery tickets for each truck load of asphaltic material delivered to the project site.
    - d. Upon completion of the weed control treatment, and as a condition for final acceptance, furnish a written certificate stating the brand name of the sterilant and the manufacturer, and that the sterilant used had at least the minimum required concentration, and that the rate and method of application complied in every respect with the conditions and standards contained herein.
- D. Samples:
1. Prior to the delivery of specified aggregate to the site, submit samples of the material for the Inspector's acceptance in accordance with SSPWC Section 4-1.4. Samples shall be typical of materials to be furnished from the proposed source and in conformance with the specified requirements.
  2. Provide aggregate base gradation and quality certifications, dated within 30 days of submittal.

#### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with Local Public Works Standards.
- B. Mixing Plant: Conform to Local Public Work Standards.
  1. Asphaltic Concrete Producers Qualifications: Use only materials furnished by a bulk asphaltic concrete producer regularly engaged in production of hot mix, hot laid bituminous concrete.
  2. Applicator Qualifications: Paving machine and roller operators shall be fully trained and experienced in the installation of asphaltic concrete paving on projects of similar size and complexity.
- C. Testing and analysis of granular base material and asphaltic concrete paving mix shall be performed under provisions of Division 1.
- D. Obtain materials from same source throughout.

#### **1.06 REGULATORY REQUIREMENTS**

- A. Where reference is made to SSPWC, the following shall apply.
  1. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including Standard Details for Public Works Construction, as amended and adopted by those authorities.
  2. Perform on-site Work as indicated and referenced on Contract Drawings and as specified herein.

- B. The quantity of volatile organic compounds (VOC) used in weed killer, seal coat, tack coat, primer, and other materials shall not exceed limits permitted under current regulations of South Coast Air Quality Management District (AQMD).

### 1.07 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen; or when rain is imminent.
  - 1. Tack Coats: Minimum surface temperature of 60 deg F.
  - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. General: Aggregate base, prime coat paint binder, bituminous surface course and other materials shall be as noted on the Contract Drawings and shall comply with requirements of authorities having jurisdiction.
- B. Asphalt Cement: ASTM D 946.
- C. Asphalt Concrete Materials: SSPWC, Subsection 203-6.
- D. Aggregate for Binder Course : Angular crushed washed stone; free of shale, clay, friable material and debris.
- E. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- F. Fiber Reinforcement: Synthetic fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 1/2 inch length.
- G. Crack Filler:
  - 1. Cracks less than 1/2 inch in width: GuardTop Crackfiller or equal.
  - 2. Cracks 1/2 inch or greater in width: #4 Sheet mix asphalt.
- H. Primer: In accordance with locally adopted 1.
- I. Tack Coat: Homogeneous, medium curing, liquid asphalt.
- J. Seal Coat: AI MS-19, slurry type.
  - 1. Asphalt Emulsion, [www.aema.org](http://www.aema.org), SS1-h, per SSPWC Section 203-9.
  - 2. Acceptable Manufacturers:
    - a. Asphalt Coating Engineering; Sure Seal.
    - b. Diversified Asphalt Product; Over Kote: [www.diversifiedasphalt.com](http://www.diversifiedasphalt.com).
    - c. SealMaster Pavement Products & Equipment; MasterSeal: [sealmaster.net](http://sealmaster.net).
    - d. Vulcan Materials Company; GuardTop: [www.vulcanmaterials.com](http://www.vulcanmaterials.com).

- e. Western Colloid Products; Park Top: [www.westerncolloid.com](http://www.westerncolloid.com).
- f. Satin Seal by Blue Diamond Co., Long Beach, CA.
- g. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.02 ASPHALT PAVING MIXES AND MIX DESIGN**

- A. Asphalt Surfacing Materials: Provide asphalt surfacing meeting the following requirement, furnished from a commercial asphalt central mixing plant.
- B. Asphalt Paving Mix:
  - 1. Standard Specifications, C2-PG-64-10.
- C. Use dry material to avoid foaming. Mix uniformly.
- D. Base Course: 4.5 to 5.8 percent of asphalt cement by weight in mixture in accordance with SSPWC Section 203-6.4.3, Type B.
- E. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with 1.
  - 1. CSS-1 h and conform to the requirements of SSPWC, Section 203-3 Emulsified Asphalt.
- F. Parking Lot Wearing Course: 4.6 to 6.0 percent of asphalt cement by weight in mixture in accordance with SSPWC, Section 203-6.4.3, Type C2.
  - 1. Provide at least two courses of asphalt when Type C2 asphalt pavement is greater than 3 inches.
  - 2. Surface Course Minimum Thickness: 1 inch and a maximum of 2 inches.
- G. Playground Area Wearing Course: 4.8 to 6.5 percent of asphalt cement by weight in mixture in accordance with SSPWC, Section 203-6.4.3, Type D2.
  - 1. Provide at least two courses of asphalt when Type D2 asphalt pavement is greater than 1-1/2 inches.
  - 2. Surface Course Minimum Thickness: 1 inch and a maximum of 1-1/2 inches.
- H. Submit proposed mix design of each class of mix for review prior to beginning of work.

## **2.03 SOURCE QUALITY CONTROL**

- A. Test mix design and samples in accordance with AI MS-2.
- B. Submit asphaltic concrete mix design proposed by the Contractor to the Engineer for review.
- C. Proposed mix to be tested for conformance with the specifications, including grading, asphalt content and stability.

## **2.04 ACCESSORIES**

- A. Headers and Stakes:
  - 1. 2 x 6 inch nominal Redwood, Construction Heart Grade, or preservative treated douglas fir (PTDF), except at curves provide laminated 1 x 6 inch nominal PTDF., unless indicated otherwise on Drawings
  - 2. Stakes: 2 x 4 x 18 inch long Redwood, or 2 x 3 x 18 inch long PTDF; at 48 inch on center maximum.
  - 3. Nails: Common, use hot dipped galvanized only, 12d minimum.

- B. Pavement Reinforcing Fabric: Non-woven polypropylene fabric conforming to SSPWC, Subsection 213-1.
  - 1. Basis of Design Product: Petromat as manufactured by Propex Fabrics inc.; [www.geotextile.com](http://www.geotextile.com), or approved equal.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Refer to geotechnical report referenced in section 8 - 8, provided under separate cover, notes on Contract Drawings, and requirements of authorities having jurisdiction.
- B. Verify that compacted subgrade and granular base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Fine grading, checking, shaping, and compacting of subgrade shall be complete before start of asphaltic concrete Work.
- E. Soil Sterilant: Sterilize soil areas to receive asphaltic concrete paving. Apply soil sterilant in accordance with manufacturer's instructions and applicable environmental regulations.
- F. Curbs and Gutters: Gutters shall be in place and cured prior to start of asphaltic concrete Work. Provide lumber ramping at all locations where rolling equipment or vehicles cross new concrete paving, curbs and gutters.
- G. Headers: Place headers with tops flush with finish asphaltic concrete surfaces. Back headers with stakes.
  - 1. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
  - 2. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of adjacent undisturbed earth.
  - 3. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid grade a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of 2-12d galvanized common nails through each stake.
  - 4. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
  - 5. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
  - 6. Provide additional stakes and anchorage as required to fasten headers in place
- H. Do not asphalt concrete on any surface, which contains ponded water or excessive moisture in the opinion of the Architect or consulting engineer.
  - 1. If paving operations are in progress and rain or fog forces a shut down, loaded trucks in transit shall return to the plant, and no compensation will be allowed therefore.

2. Provide canvas tarpaulins to cover all loads of asphalt from the time that the mixture is loaded until it is discharged from the delivery vehicle, unless otherwise directed in writing.

### **3.02 BASE COURSE**

- A. Inspector will examine the base before the paving has begun. Correct any deficiencies before the paving is started.
- B. Wherever asphaltic pavement does not terminate against a curb, gutter, or another pavement, provide and install a redwood or pressure treated Douglas fir header at the line of termination.

### **3.03 PREPARATION - PRIMER**

- A. Apply primer in accordance with manufacturer's instructions.
- B. Apply primer on aggregate base or subbase at uniform rate of 0.25 gal/sq yd.
- C. Apply primer to contact surfaces of curbs, gutters.
- D. Use clean sand to blot excess primer.

### **3.04 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with SSPWC Section 302-5.4.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 0.10 gal/sq yd.
- C. Apply tack coat to contact surfaces of curbs, gutters and previously placed or existing paving.
- D. Joining Pavement: Expose, cut and clean edges of existing pavement to straight, vertical surfaces for full depth of existing pavement.
  1. Paint edge with asphalt emulsion before placing new asphaltic concrete.
  2. Joints in New Paving: In accordance with SSPWC.

### **3.05 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

- A. Install Work in accordance with SSPWC Subsection 302-5.
- B. Asphalt concrete of the class indicated in Part 2 shall be laid in courses conforming to SSPWC Table 302-5.5(A), unless otherwise stated herein.
- C. Place asphalt within 24 hours of applying primer or tack coat.
- D. Place thickness as indicated on Civil Drawings to minimum 1 inch compacted thickness.
  1. Asphalt concrete work shall include full depth patching and variable thick asphalt concrete transition areas.
  2. Provide daily the Inspector, with copies of certificates of weight for all materials delivered to the job site and/or incorporated in the work.
  3. At no time shall the coarse aggregate that has segregated from the mix be scattered across the paved mat.
- E. Install gutter drainage grilles and frames and manhole frames in correct position and elevation.

- F. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
  - 1. Compact (roll) asphaltic concrete in accordance with SSPWC, Subsection 302-5.6, using machine rollers.
    - a. Compaction by vehicular traffic is prohibited.
    - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- G. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

### **3.06 PLACING ASPHALT PAVEMENT - DOUBLE COURSE**

- A. Provide at least two courses of asphalt when Type D2 asphalt pavement is greater than 1-1/2 inches. The surface course shall be a minimum thickness of 1 inch and a maximum of 1-1/2 inches.
- B. Provide at least two courses of asphalt when Type C2 asphalt pavement is greater than 3 inches. The surface course shall be a minimum thickness of 1 inch and a maximum of 2 inches.
- C. Install Work in accordance with SSPWC Subsection 302-5.
- D. Place asphalt binder course within 24 hours of applying primer or tack coat.
- E. Place binder course to thickness as indicated on Civil Drawings, minimum 1 inch compacted thickness.
- F. Place wearing course within two hours of placing and compacting binder course.
- G. Place wearing course to thickness as indicated on Civil Drawings, minimum 1 inch compacted thickness.
- H. Install gutter drainage grilles and frames and manhole frames in correct position and elevation.
- I. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
  - 1. Compact (roll) asphaltic concrete in accordance with SSPWC, Subsection 302-5.6, using machine rollers.
    - a. Compaction by vehicular traffic is prohibited.
    - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- J. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

### **3.07 SEAL COAT**

- A. Apply seal coat after surface course application, in accordance with manufacturer's recommendations.
- B. Apply seal coat to surface course and asphalt curbs in accordance with 1, Subsection 302-8.2.
- C. Add water to specified seal coat material. When air temperatures of 90 degrees F or more are encountered during application, consult manufacturer for recommendations.
- D. If pavement surface exhibits imperfections of roller marks, rock pockets, ridges or depressions as determined by the Architect, the addition of sand aggregate to seal coat, and amounts thereof, shall be as recommended by the manufacturer.

- E. A second application shall be made after first coat has dried to the touch. When sand is added to the first seal coat, two additional coats without extra sand shall be applied.
- F. Allow seal coat to dry before permitting traffic or striping.

### **3.08 PAVEMENT REPAIR AND PAVING**

- A. Preparation of existing pavement: Where indicated, remove loose asphaltic concrete, cleanout "pot holes" and cracks, remove dirt, oil and other foreign materials.
- B. Repair holes with full paving section as specified. Repair "alligatoring" with asphalt "skin-patch". Fill all cracks larger than 1/4 inch wide with asphalt emulsion slurry.
- C. Tack Coat: Apply asphalt oil AR-4000 or AR-8000, as required for jobsite condition, at metered application rate of no less than a range from .2 to .3 gallons per square yard of fabric or as directed by manufacturer and to provide 100 percent fabric saturation and ample bonding for paving section.
- D. Fabric Reinforcement: Place fabric smooth side up in tack coat with 2 to 4 inch overlap. Hand-broom to remove wrinkles. Apply addition tack coat to joints and between overlapped fabric layers.
- E. Overlay Asphalt: Place single course asphalt, 1-1/2 inch compacted thickness, in conformance with specified standards in this section.

### **3.09 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

### **3.10 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.
- C. Pavement at all longitudinal joints shall have a Field Density of 95%, as described in SSPWC Section 302-5.6.2.
  - 1. When the test results of the field cores are less than 95% Relative Compaction, remove a 1 foot wide section on each side of the longitudinal joint.
  - 2. Replace the removed pavement with an asphalt mix that meets the job specification at no additional cost to the District.
- D. Test: Flood test all paving to demonstrate positive drainage.
  - 1. Before acceptance, water test all pavements to ensure proper drainage as directed by the Inspector.
  - 2. Flooding Method: By water tank truck.
  - 3. Fill depressions where the water ponds to a depth of more than 1/8 inch; or the slope corrected to provide proper drainage.
  - 4. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible.



5. No standing water shall remain 1-hour after test.

### **3.11 PROTECTION**

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.
  1. After final rolling, prohibit all traffic on asphaltic concrete until mix has fully cooled and set. Minimum time, in all cases shall be 6 hours.

### **3.12 CLEANING**

- A. After completion of paving operations, clean all existing and new improvements that have been soiled, especially by oil tracking from asphalt tanks or placement in general.
- B. For Substantial Completion review, broom clean and wash paving with hoses. Clean residue from landscaping installation.

**END OF SECTION**



**SECTION 32 13 13**  
**CONCRETE PAVING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete sidewalks and integral curbs.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 07 92 00 - Joint Sealants: Sealing joints.

**1.03 REFERENCE STANDARDS**

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete; 2016.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- D. ACI 305R - Guide to Hot Weather Concreting; 2010.
- E. ACI 306R - Guide to Cold Weather Concreting; 2016.
- F. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).
  - 1. Use 2014 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- G. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
  - 1. Use 2012 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- I. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2011.
- J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).
  - 1. Use 2013 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2018.
  - 1. Use 2014a as indicated in 2016 CBC Ch. 35 Referenced Standards.
- M. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
  - 1. Use 2012 as indicated in 2016 CBC Ch. 35 Referenced Standards.
- N. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

- O. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- P. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- Q. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018.
- R. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine; 2011.
- S. SSPWC (Greenbook) - Greenbook: Standard Specifications for Public Works Construction; Current Adopted Edition.

#### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.

#### **1.05 QUALITY ASSURANCE**

- A. Lines and Levels: Established by State of California licensed Surveyor or registered Civil Engineer. Costs of surveying services shall be included in the Contract Sum.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

### **PART 2 PRODUCTS**

#### **2.01 PAVING ASSEMBLIES**

- A. Comply with applicable requirements of ACI 301.
- B. Concrete Sidewalks: 3,000 psi 28 day concrete, thickness as indicated on Drawings, minimum 4 inches, natural grey color Portland cement.

#### **2.02 REGULATORY REQUIREMENTS:**

- A. Conform to California Code of Regulations (CCR), Volume 2, Part 2, Chapters 18A and 19A.
- B. Conform to California Building Code (CBC), Volume 2, Chapter 11B and ADA Standards for accessibility requirements.
  - 1. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.
  - 2. Concrete paving and concrete finishes along accessible routes of travel shall be at least as slip-resistant as that described as a medium salted finish for slopes of less than 6%, and slip resistant at slopes of 6% or greater; CBC 11B-403.2.
  - 3. Continuous surfaces, including walks and sidewalks, shall have a continuous common surface, not interrupted by steps or by abrupt changes in level exceeding 1/4 inch vertical (CBC 11B-303.2), or beveled at 1:2 slope to a maximum height of 1/2 inch (CBC 11B-303.3) and shall have a minimum width of 48 inches; CBC 11B-403.5.1.
  - 4. Surface cross slopes shall not exceed 2 percent on any accessible path of travel.
- C. Albedo Reflectance of Finish Concrete: 0.30, minimum.

### 2.03 FORM MATERIALS

- A. Wood form material, profiled to suit conditions.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
  - 1. Thickness: 1/2 inch.

### 2.04 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars; unfinished.
- B. Dowels: ASTM A615/A615M, Grade 60 - 60,000 psi yield strength; deformed billet steel bars; unfinished finish.

### 2.05 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M, Sulfate Resistant - Type V Portland cement, gray color.
- C. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- D. Water: Clean, and not detrimental to concrete.
- E. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing, Type C - Accelerating, and Type G - Water Reducing, High Range and Retarding.
  - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

### 2.06 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1-D, Class A.
  - 1. Comply with all applicable air pollution requirements.
- B. Liquid Surface Sealer:
  - 1. High solids, acrylic curing and sealing compound: Minimum 30% non-yellowing, acrylic solids curing compound; shall conform to ASTM C309 and ASTM C1315, Type I, Class A, VOC compliant.
    - a. Acceptable Products:
      - 1) L&M Construction Chemicals, Inc.; Dress & Seal WB: [www.lmcc.com](http://www.lmcc.com).
      - 2) L.M. Scofield Company; Cureseal-W: [www.scofield.com](http://www.scofield.com).
      - 3) W. R. Meadows Company; Decra-Seal W/B: [www.wrmeadows.com](http://www.wrmeadows.com).
      - 4) Substitutions: See Section 01 60 00 - Product Requirements.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
  - 1. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.

### 2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
  - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- D. Concrete Properties:
  - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; As indicated on drawings.
  - 2. Water-Cement Ratio: Maximum 50-60 percent by weight, or according to indicated concrete strength..

## **2.08 MIXING**

- A. Transit Mixers: Comply with ASTM C94/C94M.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

### **3.04 PREPARATION**

- A. Project Conditions:
  - 1. Water and Dust Control: Maintain control of concrete dust and water at all times. Do not allow adjacent planting areas to be contaminated.
- B. Moisten base to minimize absorption of water from fresh concrete.
- C. Notify Architect minimum 24 hours prior to commencement of concreting operations.

### **3.05 COORDINATION WITH EXISTING CONSTRUCTION**

- A. Connection to Existing Construction: Where new concrete is doveled to existing construction, drill holes in existing concrete, insert steel dowels and pack with non-shrinking grout.
- B. Preparation of Existing Concrete: Prepare previously placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions.

### **3.06 FORMING**

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

### **3.07 REINFORCEMENT**

- A. Place reinforcement at midheight of slabs-on-grade.

1. Locate reinforcement to provide required cover by concrete. If not otherwise indicated on Drawings, provide concrete cover in compliance with ACI 318.
  2. Reinforcement Spacing: Space reinforcement as indicated on Drawings or in Standard Specifications, whichever is more stringent. If not indicated, maintain clear spacing of two times bar diameter but not less than 1-1/2 inch nor less than 1-1/3 times maximum size aggregate.
  3. Reinforcement Supports: Provide load bearing pads under supports or provide precast concrete block bar supports.
- B. Interrupt reinforcement at contraction and expansion joints.
- C. Place dowels to achieve pavement and curb alignment as detailed.
1. Secure tie dowels in place before depositing concrete.
  2. Provide No. 3 bars, 18 inch long at 24 inches O.C. for securing dowels where no other reinforcement is provided.

### **3.08 COLD AND HOT WEATHER CONCRETING**

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

### **3.09 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 304R.
  1. Mixing: If batch plant is within travel time not exceeding maximum limits, transit mix concrete in accordance with ASTM C94/C94M. If travel time exceeds limits, provide alternative means for mixing and submit for review and approval.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Place concrete to pattern indicated.

### **3.10 JOINTS**

- A. Align curb, gutter, and sidewalk joints.
- B. Place 1/2 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
  1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
  2. Secure to resist movement by wet concrete.
  3. If expansion joints are not indicated, conform to SSPWC (Greenbook) and standard details and specifications of authorities having jurisdiction.

- C. Provide sawn joints.
  - 1. At 5 feet intervals for pedestrian paving.
  - 2. At 10 feet intervals for vehicle paving.
  - 3. Between sidewalks and curbs.
  - 4. Between curbs and pavement.
- D. Provide keyed joints as indicated.
- E. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.
- F. Refer to Architectural, Landscape and Civil Drawings for additional information and joint locations.

### 3.11 FINISHING

- A. Area Paving: Medium broom, texture perpendicular to pavement direction..
- B. Sidewalk Paving: Medium broom, texture perpendicular to pavement direction with troweled and radiused edge 1/4 inch radius.
  - 1. Broomed: Pull broom across freshly floated concrete to produce medium texture in straight lines perpendicular to main line of traffic. Do not dampen brooms.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- D. Specific Finishes: Where indicated on Drawings.
  - 1. Concrete Paving Finish: ACI 301, two-step trowel finish, followed after surface has achieved initial set by flooding of surface and light rubbing with bristle brush so that concrete fines are exposed slightly.
    - a. Finish surface less than 6 percent shall receive medium broom finish resembling medium grit sandpaper. CBC 11B-403 and 11B-302.1.
    - b. Finish surface greater than 6 percent shall receive heavy broom finish. CBC 11B-403 and 11B-302.1.
    - c. Surfaces shall have static coefficients of friction of 1.3 to 1.6 (dry) and 1.2 to 1.4 (wet) when field tested in accordance with ASTM D2047.
- E. Place sealer on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

### 3.12 TOLERANCES

- A. ACI 301, Class B, except paving in public rights-of-way shall conform to SSPWC (Greenbook).
- B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- C. Maximum Variation From True Position: 1/4 inch.
- D. Control-joint grooves and other conspicuous lines:
  - 1. 1/4 inch maximum in any 20 feet.
  - 2. 1/2 inch maximum in any 40 feet.
- E. Variation in Cross-Sectional Thickness of Slabs:
  - 1. Minus 1/4 inch.



2. Plus 1/2 inch.
- F. Variation in Radii
1. In radii of less than 10 feet:
    - a. 1/8 inch in any 5 feet.
    - b. 1/4 inch in any 10 feet.
  2. In radii of 20 feet:
    - a. 1/4 inch in any 10 feet.
    - b. 3/8 inch in any 20 feet
  3. In radii of 30 feet or more:
    - a. 1/2 inch in any 20 feet.
    - b. 1 inch in any 30 feet.
- G. Coefficient of Friction for Finish Surface:
1. Pedestrian Vehicular Finish Surface: Minimum 0.6 static coefficient of friction is required for all concrete paving finish surface. All concrete paving surfaces to be broom finish.
  2. Ramps: Minimum 0.8 static coefficient of friction is required for all concrete paving finish surfaces on ramps. All concrete paving surfaces on ramps to be broom finish.

### **3.13 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
1. Provide free access to concrete operations at project site and cooperate with appointed firm.
  2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
  3. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd or less of each class of concrete placed.
1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
  2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

### **3.14 PROTECTION**

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
1. Provide lumber ramping and plywood covering where curbs and gutters are subject to vehicular and equipment traffic during construction.

**END OF SECTION**



**SECTION 32 17 23.13**  
**PAINTED PAVEMENT MARKINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Parking lot markings, including parking bays, crosswalks, accessibility symbols, and curb markings.
- B. "No Parking" curb painting.
- C. Playground markings.
- D. Existing Striping: Confirm compliance at all accessible parking spaces on site and path of travel with California Building Code and Access requirements.
  - 1. Remove non-compliant and provide all striping and modifications necessary for compliance.

**1.02 RELATED REQUIREMENTS**

- A. Section 32 12 16 - Asphalt Paving.
- B. Section 32 1313 - Concrete Paving: Surface for painting.
- D. Section 32 17 26 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. FED-STD-595C - Colors Used in Government Procurement (Fan Deck); 2008 (Chg Notice 1).
- C. FS TT-B-1325 - Beads (Glass Spheres); Retro-Reflective; 2007d (Validated 2017).
- D. FS TT-P-1952 - Paint, Traffic Black, and Airfield Marking, Waterborne; 2015f.
- E. SAE AMS-STD-595 - Colors Used in Government Procurement; 2017a.
- F. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- G. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.
- H. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.

- C. Certificates: Submit for each batch of paint and glass beads stating compliance with specified requirements.
- D. Maintenance Materials: Furnish the following for District's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Paint: 2 containers, 1 gallon size, of each type and color.

### **1.05 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions regarding CalGreen requirements.
    - a. Comply at time of installation with Air Quality standards of:
      - 1) South Coast Air Quality Management District, SCAQMD 1113.
      - 2) California Air Resources Board (CARB).
  - 2. For accessibility markings see Part 3 Article "Installation".
  - 3. Conform to State of California, Department of Transportation (CALTRANS) Standard Specifications, Section 84, Traffic Control Markings, as amended and adopted by authorities having jurisdiction.
  - 4. Where reference is made to Standard Specifications, the following shall apply.
    - a. Perform on-site Work as indicated and referenced on the Contract Drawings and as specified herein.
- B. Applicator Qualifications: Company regularly engaged in pavement marking, well-experienced in use of machine-applied painted stripes and other markings, with three years of verifiable experience.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment accompanied by batch certificate.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### **1.07 FIELD CONDITIONS**

- A. Do not install products under environmental conditions outside paint manufacturer's absolute limits.
  - 1. Do not apply marking paint when weather is foggy or rainy, or when ambient or pavement temperatures are below 40 degrees F., or when such conditions are anticipated within eight hours of application.
- B. Do not apply marking paint when wind velocity causes uncontrollable overspray or excessively rapid drying.

- C. Sequence and Schedule: Apply pavement markings after asphaltic concrete and portland cement concrete and interlocking concrete paving Work are complete and properly cured and, if applicable, sealer has been applied to asphaltic concrete and landscaping Work is complete.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. General: Provide standard factory-mixed, quick drying and non-bleeding colors, conforming to Standard Specifications, as amended and adopted by the AHJ, City, and County, as applicable.
- B. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.
  - 1. Parking Lots: Fast-dry type. If required by authorities having jurisdiction for Work in public rights-of-way, include reflective material in paint. Paint for marking curbs shall not require reflective material. See Color Schedule in Part 3.
  - 2. Accessibility Symbols: Blue shall conform to Color No. 15090, FED-STD-595C. (SAE AMS-STD-595)
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Paint For Obliterating Existing Markings: FS TT-P-1952; black for bituminous pavements, gray for portland cement pavements.
- D. Reflective Glass Beads at accessible parking: FS TT-B-1325, Type I (low index of refraction), Gradation A (coarse, drop-on); with silicone or other suitable waterproofing coating to ensure free flow.
  - 1. Comply with CALTRANS State Specification No. 8010-51J-22, Type II, and CBC Section 11B-502.6 Identification.
- E. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. 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. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove by sandblasting existing paint to be eliminated.
  - 1. Repair asphaltic surface by applying a slurry seal coat.

2. Restripe where indicated.
- D. Clean surfaces thoroughly prior to installation.
1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
  2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
  3. Sandblasting: Use equipment of size and capacity necessary, providing not less than 150 cfm of air at pressure not less than 90 psi at each nozzle used.
- E. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- F. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
1. Lay out markings as shown on Drawings. Use guide lines, templates and forms for precise edges and spacings.
    - a. At off-site and on-site public rights-of-way, obtain review and approval of layout by authorities having jurisdiction.
- G. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
  2. At Contractor's option, temporary marking tape may be used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to District.

### 3.03 INSTALLATION

- A. General: Using proper masking, stencils and application equipment, apply marking paint at rate recommended by paint manufacturer or approximately one gallon per 150 square feet (equivalent to approximately one gallon for 450 lineal feet of 4-inch wide stripe), whichever is greater.
1. Equipment shall be capable of operating at 125 psi air pressure, agitate paint constantly and hold exactly to the alignment.
  2. Equipment used for applying reflectorized striping shall be equipped with a bead dispenser capable of applying beads at the specified rate.
- B. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- C. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
- D. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.

- E. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- F. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- G. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
  - 1. Apply paint in one coat only.
  - 2. Wet Film Thickness: 0.015 inch, minimum.
  - 3. Length Tolerance: Plus or minus 3 inches.
  - 4. Width Tolerance: Plus or minus 1/8 inch.
- H. Curbs: Paint full vertical face and first 6-inches of horizontal plane at top of curb or combination curb/paving. Provide minimum 2 coats paint.
  - 1. Provide stenciled text in the height, spacing and typeface as indicated on Drawings.
- I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.
- J. Recreational Areas: Provide minimum 2 coats paint.

**3.04 DRYING, PROTECTION, AND REPLACEMENT**

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
  - 1. Prevent construction activities over completed markings, except light vehicular and pedestrian traffic.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Touch-up paint as required to provide clean, straight lines and full coverage of surfaces.
- E. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- F. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- G. Replace removed markings at no additional cost to District.
  - 1. Clean up all oil, paint splatters and other stains from surfaces in preparation for Substantial Completion review.

**3.05 COLOR SCHEDULE**

- A. Parking and On-Site Roadways

<u>Location</u>	<u>Color</u>	<u>Reflectance**</u>
Driving lane striping	White	82%
Parking space striping	White	82%

Accessible Parking, ISA, and zone markings	Blue No. 15090 per FED-STD-595C (SAE AMS-STD-595)	52%
Accessible loading and cross-hatching	A. White with Blue perimeter at Asphalt Paving. B. Blue at Concrete Paving*	82% / 52% 52%
12 inch high Text: "NO PARKING", "LOADING ZONE", and "FIRE LANE", etc.	White	82%
Firelanes / No Parking zone markings Special Use Markings	Red No. 31350 per FED-STD-595C (SAE AMS-STD-595)	52%
Loading zone markings	Orange Yellow No. 33538 per FED-STD-595C (SAE AMS-STD-595)	52%
Directional arrows	White	82%
Speed Bumps	Orange Yellow No. 33538 per FED-STD-595C (SAE AMS-STD-595)	52%
Black special-use pavement markings, if indicated on Drawings	Black No. 37038 per FED-STD-595C (SAE AMS-STD-595)	NA

\*Contrasting color per CBC.

a. See also Division of the State Architect IR 11B-7.

\*\*Daylight directional reflectance (without glass beads) , when tested in accordance with Federal Test Method Standard 141A, Method 612.

### END OF SECTION