STATE OF CALIFORNIA DEPARTMENT OF GENERAL SERVICES

REAL ESTATE SERVICES DIVISION
PROJECT MANAGEMENT AND DEVELOPMENT BRANCH

PROJECT MANUAL

INTRODUCTORY INFORMATION
BIDDING REQUIREMENTS
CONTRACTING REQUIREMENTS
SPECIFICATIONS

FOR:

CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM) CONFERENCE CENTER, STORAGE AND LIBRARY IMPROVEMENTS, RE-ROOF AND HVAC UPGRADES

CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM)

LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA

Project Director: Dianna C. Brown
West Sacramento, California

Consultant: IBI GROUP

MARCH 2022

000000000004359

DOCUMENT 00 01 01

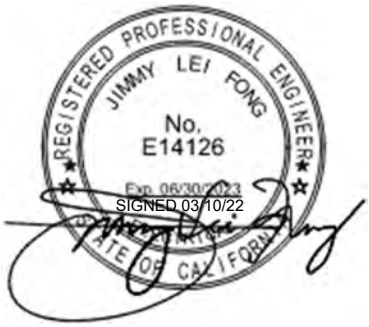
PROJECT TITLE PAGE

Title	:	CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM) CONFERENCE CENTER, STORAGE AND LIBRARY IMPROVEMENTS, RE-ROOF AND HVAC UPGRADES
Client Agency	:	CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM)
Location	:	600 STATE DRIVE LOS ANGELES, LOS ANGELES COUNTY
Project Number	:	000000000004359
Project Director	:	Dianna C. Brown State of California Department of General Services Real Estate Services Division Project Management and Development Branch 707 Third Street, 4th Floor West Sacramento, California 95605 Telephone Number: (279) 946-8626 Email: Dianna.Brown@dgs.ca.gov
Consultant	:	IBI GROUP Angela Ball 537 S Broadway, Suite 500 Los Angeles, CA 90013 Telephone Number: (213) 769-0011 Email: Angela.Ball@IBIGroup.com

DOCUMENT 00 01 05

CERTIFICATIONS PAGE

PROJECT TITLE	:	CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM) CONFERENCE CENTER, STORAGE AND LIBRARY IMPROVEMENTS, RE-ROOF AND HVAC UPGRADES
CLIENT AGENCY	:	EXPOSITION PARK-CALIFORNIA AFRICAN AMERICAN MUSEUM
LOCATION	:	LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA
PROJECT NUMBER	:	000000000004359
OWNER	:	STATE OF CALIFORNIA
PROJECT DIRECTOR	:	Dianna Brown Department of General Services Project Management and Development Branch 707 Third Street, 4th Floor West Sacramento, California 95605 Email : dianna.brown@dgs.ca.gov
CONSULTANT	:	IBI Group 1001 Wilshire Blvd., Suite 100 #3100 Los Angeles, CA 90017

		
ARCHITECT	STRUCTURAL ENGINEER	MECHANICAL ENGINEER
		
ELECTRICAL ENGINEER	MECHANICAL ENGINEER – HVAC SCOPE ONLY	ELECTRICAL ENGINEER – HVAC SCOPE ONLY

PROJECT TITLE	:	CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM) CONFERENCE CENTER, STORAGE AND LIBRARY IMPROVEMENTS, RE-ROOF AND HVAC UPGRADES
CLIENT AGENCY	:	EXPOSITION PARK-CALIFORNIA AFRICAN AMERICAN MUSEUM
LOCATION	:	LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA
PROJECT NO.	:	000000000004359

REGULATORY REVIEWS:

OFFICE OF THE STATE FIRE MARSHAL **APPROVED FIRE AND PANIC ONLY** **04/26/22** **21-2731** **Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.**	IDENTIFICATION STAMP DIV. OF THE STATE ARCHITECT APP: 03-121785 INC: REVIEWED FOR SS ☐ FLS ☐ ACS ☑ DATE: 04/29/2022
STATE FIRE MARSHAL	ACCESS COMPLIANCE

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STATE OF CALIFORNIA

DEPARTMENT OF GENERAL SERVICES

REAL ESTATE SERVICES DIVISION

DOCUMENT 00 21 00

INSTRUCTIONS TO BIDDERS

Index

May 2018 Edition

DOCUMENT 00 21 00
INSTRUCTIONS TO BIDDERS

1. GENERAL

1.1 Bidder shall examine these instructions carefully and be responsive to conditions with which must be complied with prior to bid.

1.2 Bidders shall be aware of the requirements of codes referenced in the Bidding Requirements and in the Contract Documents. Bidders may access codes included in California law through publications or through the Internet. The web site for California law is: http://leginfo.legislature.ca.gov/faces/codes.xhtml.

2. COMPETENCE OF BIDDERS

2.1 License:

.1 Bidder may only bid on work for which Bidder is properly licensed by the Contractors' State License Board.

.2 Joint venture Bidders must possess a joint venture license. Each party to a joint venture shall be properly licensed for the Work of this Project.

2.2 Prior Disqualification: Public Contract Code Section 10162 provides that a bid may be rejected on the basis of a Bidder, any officer of such Bidder, or any employee of such Bidder who has a proprietary interest in such Bidder, having been disqualified, removed or otherwise prevented from bidding on, or completing a Federal, State or Local project because of a violation of a law or a safety regulation.

If the answer to the questionnaire included in the Bid Form is "yes" the Department will review the circumstances presented and if the Director deems acceptance of the bid is not in the best interest of the State, bid may be rejected.

2.3 Employment of Undocumented Aliens: Pursuant to Section 6101 of the Public Contract Code, the State may not award a public works contract to a bidder or contractor, nor shall a bidder or contractor be eligible to bid for or receive a public works contract, who has, in the preceding five years, been convicted of violating a state or federal law respecting the employment of undocumented aliens.

2.4 Contractor Registration:

.1 Pursuant to Sections 1725.5 and 1771.1 of the Labor Code, all contractors and subcontractors must be currently registered with the Department of Industrial Relations in order to qualify to bid on; be listed in a bid proposal, subject to the requirements of Section 4104 of the Public Contract Code; or engage in the performance of any contract for public work.

.2 Limited exceptions for Joint Venture Bidders and Projects with Federal Funds may apply pursuant to Section 1771.1 of the Labor Code.

2.5 Ineligible Subcontractors: Pursuant to Section 1777.1 or 1777.7 of the Labor Code, a contractor is prohibited from bidding on, being awarded or performing work on a public works project with a subcontractor who is ineligible to perform work on the public works project. Refer to the General Conditions of the Contract for Construction, Article 4.1.3.

2.6 Asbestos Abatement Certification: If Contractor performs the asbestos abatement work; Contractor must be certified for asbestos abatement work by the Contractors' State License Board. If Contractor subcontracts the asbestos abatement work, Contractor need not be certified for asbestos abatement, but the subcontractor must be certified by the Contractor's State License Board.

2.7 Hazardous Substance Removal Certification: If Contractor performs the hazardous substance removal work or remedial action; Contractor must be certified for hazardous substance removal work by the Contractors' State License Board. If Contractor subcontracts the hazardous substance removal work or remedial action, Contractor need not be certified for hazardous substance removal, but the subcontractor must be certified by the Contractor's State License Board.

3. EXAMINATION OF BID DOCUMENTS AND SITE

3.1 Bidder's Responsibility:

.1 Bidder shall carefully examine the Work site, Drawings, and Specifications (contract documents). This includes reference only documents that will not be part of the agreement, but are provided in addition to documents that will be part of the agreement. See the Office of State Publishing Plan Room https://www.ospplanroom.com/ (Details tab, Documents folder) for reference only documents.

.2 By submitting a bid, Bidder acknowledges that the Bidder understands the character, quality and quantity of surface, locations of utilities, subsurface materials, or obstacles to be encountered; insofar as this information is reasonably ascertainable from inspection of the Work site, Drawings, and Specifications.

.3 Bidder's examination shall include all exploratory work done by the State, as well as information presented in the Drawings, Specifications, and other documents as available.

3.2 Refer to Document 00 11 00, Invitation to Bid, for availability of bidding documents.

3.3 Failure by Bidder to acquaint itself with available information will not relieve Bidder from responsibility for estimating properly the difficulty or cost of successfully performing the Work.

3.4 In connection with the foregoing, Bidder's attention is invited to Paragraphs 3.1 and 9.1 of Document 00 72 00, General Conditions of the Contract for Construction.

4. DISCREPANCIES, CONFLICTS, OMISSIONS, OR ERRORS

4.1 If discrepancies, conflicts, omissions or errors are found in the Drawings and the Project Manual prior to the date of bid opening, Bidder shall request clarification from the State's Representative identified in the Project Manual. Bidder shall submit request on Request for Bidding Interpretation Form, Appendix 00 21 00.1.

4.2 Clarifications will be given only in the form of Addenda to all Bidders.

4.3 If no Addenda are issued related to supposed discrepancy, conflict, omissions or errors in figuring the Work, Bidders shall consider that discrepancies, conflicts, or omission between Drawings and Specifications shall be governed by Paragraph 1.5 of Document 00 72 00, General Conditions of the Contract for Construction.

4.4 Omission of an item in either the Specifications or Drawings does not create a discrepancy or conflict.

5. BIDDING DOCUMENTS

5.1 Bid Form: All bids must be on the forms provided by the Department of General Services. Bid not on the forms provided will be considered nonresponsive.

5.2 Completing the Bid Form:

.1 Bidder's name should be the same as listed on Bidder's license.

.2 Price(s) shall be in the manner required by the Bid Form.

.3 Bid Form shall be signed by Bidder or duly authorized representative.

1) If Bidder is an individual, name must be shown.
2) If Bidder is a partnership, name of the partnership must be shown and one or more partners shall sign the Bid Form.
3) If Bidder is a corporation, name of the corporation must be shown, the state of incorporation must be listed, the title of the signor must be shown, and the corporate seal must be used.
4) Bidder business and mailing address should be shown.

5.3 Required Listing of Proposed Subcontractors:

.1 Failure to list kind of Work, Name, or Location shall cause the bid to be rejected as non-responsive.

.2 Bidders' attention is directed to other provisions of the Subletting and Subcontracting Fair Practices Act, beginning with Public Contract Code Section 4100, related to penalties for failure to comply with the Act by using unauthorized subcontractors or by making unauthorized substitutions. See General Conditions of the Contract for Construction, Paragraph 1.1, for definition of subcontractor, and Article 4 for further reference to subcontractors.

.3 Bidder's attention is directed to Labor Code Section 1771.1, relating to inadvertent errors in the listing of subcontractors not currently registered with the Department of Industrial Relations.

5.4 Bidders Security:

.1 All bids shall be accompanied by the following forms of bidder's security: Bidder's Bond, cashier's check, certified check or cash. Bidder's Bond shall be executed by an admitted surety insurer, authorized to issue surety bonds in the State of California. Bond and checks shall be made payable to the director of the Department of General Services. The security shall be in an amount equal to at least 10 percent of the amount bid. A bid shall not be considered responsive unless one of the forms of bidder's security is enclosed with it.

.2 If Bidder's security is a Bidder's Bond, it must be executed on the form attached to the Bid Form.

5.5 Small Business:

.1 A five percent (5%) small business preference will be granted to Bidders certified as "Small Business" in accordance with Section 1896 et. Seq., Title 2, California Code of Regulations.

.2 If the Bidder is not already a Certified Small Business, applications for certification as "Small Business" must be submitted to the Office of Small Business and DVBE Certification (OSDS), 707 3rd Street, First Floor, Suite 1-400, West Sacramento, CA 95605; https://www.dgs.ca.gov/PD/About/Page-Content/PD-Branch-Intro-Accordion-List/Office-of-Small-Business-and-Disabled-Veteran-Business-Enterprise/Certification-Program. Firms can apply for small business certification online at https://www.dgs.ca.gov/PD/Services/Page-Content/Procurement-Division-Services-List-Folder/Certify-or-Re-apply-as-Small-Business-Disabled-Veteran-Business-Enterprise.

.3 Submit a copy of your OSDS certification letter with the Bid Form.

.4 Pursuant to Section 1896.14, in order to receive the small business preference, bidders must have a completed application (including proof of annual receipts) on file with the OSDS. The bidder must have requested a preference from OSDS and meet all applicable requirements under the subchapter and the State Small Business Procurement and Contract Act, (including but not limited to evidence to rebut presumptions) not later than five o'clock (5:00 p.m.) on the date on which the subject bid is opened.

5.6 Non-Small Business:

.1 The application of the five percent (5%) small business bidding preference is now extended to a bidder, whose business is not certified as a small business but commits to subcontracting at least twenty-five percent (25%) of its net bid price to businesses that are California certified small businesses and/or microbusinesses.

When applicable this preference will be granted when the non-small business:

- Has been determined to be a responsible bidder and submitted a timely responsive bid.
- Completes Document 00 43 16-2 list of California Certified Small Businesses that he/she commits to subcontract with for a commercially useful function in the performance of the project and submits this document no later than forty-eight (48) hours after the time of receipt of bids. Ascertain that the Bidder's Name and project Work Order number are noted. **If bidder fails to submit a properly completed Document 00 43 16-2 within 48 hours after the time of receipt of bids, the claim for non-small business preference will be denied.**

Submit completed Document 00 43 16-2 to Department of General Services, Administration Division, Office of Business and Acquisition Services, Contract Management Section, 707 3rd Street, Suite 2-300, West Sacramento, CA 95605 or by fax to (916) 376-1778.

6. SUBMISSION OF BID FORMS

6.1 It is the sole responsibility of the Bidder to see that its bid is received in proper time. Bid received after scheduled closing time for receipt of bids will be returned to Bidder unopened.

6.2 Bid Forms shall be submitted under sealed cover, plainly identified as a bid for the work of the Project being bid upon and addressed as directed in the Invitation to Bid and the Bid Form. Failure to do so may result in a premature opening of, or failure to open such bid. Bid Forms improperly marked may be disregarded.

7. WITHDRAWAL OF BID FORMS

7.1 Bids may be withdrawn prior to the time fixed in the public notice for opening of bids, provided that

a request in writing, executed by Bidder or Bidder's authorized representative, for withdrawal of such bid is filed with the Administration Division, Office of Business and Acquisition Services, Contract Management Section, or the Director of General Services at the location of the bid opening. Oral, facsimile, electronic, telegraphic, or telephonic request to withdraw the Bid Form is not acceptable. Withdrawal of a bid shall not prejudice the right of a Bidder to file a new bid.

7.2 This article does not authorize withdrawal of any bid after the time fixed in the Invitation to Bid for opening of bids.

8. PUBLIC OPENING OF BIDS

Bids will be publicly opened and read at time and place indicated in Invitation to Bid. Bidders or their authorized agents are invited to be present.

9. REJECTION OF IRREGULAR BIDS

9.1 Bids may be rejected if they show any alterations of form, additions not called for, conditional bids, incomplete bids, erasures, or irregularities of any kind. If bid amount is changed after the amount is originally inserted, the change must be initialed.

9.2 When Bid Form is signed by an agent, other than the officer or officers of a corporation authorized to sign contracts on its behalf, or are signed by an agent other than a partner of a partnership, or by an agent for an individual, a power of attorney must be on file with the Department of General Services prior to opening bids or shall be submitted with the Bid Form; otherwise the bid will be rejected as irregular and unauthorized.

10. COMPETITIVE BIDDING

10.1 If more than one Bid Form is offered by an individual, firm, partnership, corporation, association, or any combination thereof, under the same or different names, all such Bid Forms may be rejected. A party who has quoted prices on materials or work to a Bidder is not thereby disqualified from quoting prices to other Bidders, or from submitting a bid directly for materials or work.

10.2 Bidders are put on notice that any collusive agreement fixing the prices to be bid so as to control or affect awarding of the Contract is in violation of competitive bidding requirements of the State Contract Act and may render void any Contract let under such circumstances.

11. AWARD OF CONTRACT

11.1 The right is reserved to reject any and all bids and waive any irregularity in any bid received.

11.2 Award of the Contract, if awarded, will be to the lowest responsible Bidder whose Bid Form complies with all requirements prescribed.

.1 Such award, if made, will be made within 45 days after opening of bids.

.2 If lowest responsible Bidder refuses or fails to execute the Contract, the Director of General Services may award the Contract to the second lowest responsible Bidder. Such award, if made, will be made within 60 days after opening of bids.

.3 If second lowest responsible Bidder refuses or fails to execute the Contract, the Director of General Services may award the Contract to the third lowest responsible Bidder. Such award if made, will be made within 75 days after opening of bids.

11.3 The above time periods within which award of Contract may be made are subject to extension of such further period as may be agreed upon in writing between the Department of General Services and the Bidder concerned.

11.4 When Project is segregated into more than one prime Contract, and a Bidder upon one of the prime Contracts fail or refuses to execute the Contract, then the time for award of such Contract will be extended as provided by this Article, and the time for award of each of the other segregated prime Contracts will be extended by an equivalent length of time, if required.

12. SUBSTITUTION OF ALTERNATIVE MATERIALS, ARTICLES, OR EQUIPMENT

12.1 Pursuant to Public Contract Code Section 3400, alternative material(s), article(s), or equipment that are of equal quality and of required characteristics for the purpose intended may be proposed during the bidding period; for use in the Work, provided the Bidder complies with the following requirements:

.1 Proposals for alternative material(s), article(s), or equipment, requested during the bidding period, shall be submitted in writing, not later than the deadline date and time identified on the Request for Bidding Interpretation (RFBI), Appendix 00 21 00.1.

.2 The proposal will not be considered unless the submittal is accompanied by complete information and descriptive data necessary to determine equality of offered material(s), article(s) or equipment. Samples shall be provided when requested by the State. Burden of proof as to comparative quality, suitability, and performance of offered material(s), article(s), or equipment shall be upon the Bidder submitting the proposal. The State will be the sole judge as to such matters. In the event the State rejects the use of such alternative(s) submitted, then one of the particular products originally specified in the Contract Documents shall be furnished. If the proposal is accepted, all Bidders will be notified by Addendum.

.3 Refer to the General Conditions of the Contract for Construction, Clauses 2.2.7 and 3.12.10, for substitution requests after Contract Award.

13. RETURN OF BIDDER'S SECURITY

13.1 Within 10 days after the award of the Contract, the Department of General Services will return all Bidder's security, other than Bidder's Bonds, accompanying the Bid Forms that are not to be fully considered in making the award.

13.2 Retained Bidder's security will be held until the Contract has been fully executed, after which all Bidder's security, except Bidder's Bonds, will be returned.

14. CONTRACT BONDS

Contractor will be required to furnish in duplicate the Performance Bond and Payment Bond required by the State Contract Act, each in the amount of 100 percent of the Contract amount; as set forth in Paragraph 11.3 of Document 00 72 00, General Conditions of the Contract for Construction.

15. INSURANCE

Contractor will be required to furnish to the State, concurrently with execution of the Contract, a certificate of insurance coverage as required by Paragraph 11.1 of Document 00 72 00, General Conditions of the Contract for Construction.

16. EXECUTION OF CONTRACT

16.1 Contract shall be signed by successful Bidder and returned within 7 days of receipt. The Contract shall not be binding upon the State until it is executed by the Contractor and the State. Contract Documents required for execution of the Contract consist of the following:

.1 Agreement, Document 00 52 00.

.2 Contract Bonds.

.3 Certificate of Insurance.

.4 Signed set of Drawings and Project Manual for filing with the Contract.

16.2 Should Contractor begin work in advance of receiving notice that the Contract has been approved, any work performed in advance of the date of approval shall be considered as having been done at risk as a volunteer. In no event shall Contractor commence work until Contractor has received notification from the State that the certificate of insurance has been approved.

17. FAILURE TO EXECUTE CONTRACT

Failure to execute Contract within *7* days after successful Bidder has received Contract for execution may be cause for forfeiture of Bidder's security. Failure to provide required bonds and insurance constitutes failure to execute Contract*.*

18. PARTICIPATION IN DISABLED VETERANS BUSINESS ENTERPRISES (DVBE) PROGRAM

18.1 Pursuant to Section 10115 et seq. of the Public Contract Code, and Section 999 et seq. of the Military and Veterans Code, the Department of General Services has established an overall goal of not less than 3% participation by Disabled Veteran Business Enterprises (DVBE). However, these DVBE Participation Requirements may be modified for this project; reference Document 00 22 10 of the Project Manual for the percentage requirements.

18.2 Bids will only be accepted from those Bidders that certify that they have achieved the required participation, as outlined in Document 00 22 10 of the Project Manual, and as set forth in the Bid Form.

18.3 Applicants for DVBE certification may apply online at https://www.dgs.ca.gov/PD/Services/Page-Content/Procurement-Division-Services-List-Folder/Certify-or-Re-apply-as-Small-Business-Disabled-Veteran-Business-Enterprise. DVBE applicants must submit specific support documentation to the OSDS.

18.4 Bidder's attention is directed to the requirement that certifications and documentation must be submitted with the bid; otherwise bids will be considered non-responsive.

BIDDERS ARE ADVISED TO COMMENCE THE REQUIRED DVBE PROCEDURES IMMEDIATELY UPON RECEIPT OF DRAWINGS AND SPECIFICATIONS, OR NOT LESS THAN THREE (3) WEEKS PRIOR TO THE BID OPENING, WHICHEVER OCCURS FIRST.

18.5 DVBE INCENTIVE

.1 A DVBE Incentive will be granted to Bidders in accordance with Section 999.5(a) and (d) of the Military and Veterans Code and California Code of Regulations 1896.98 et seq.

.2 The DVBE Incentive will be applied during the bid evaluation process and will only be applied to responsive bids from responsible bidders proposing the percentage(s) of DVBE Participation

for the DVBE Incentive specified in the solicitation. Any Small Business Preference must be calculated prior to the DVBE Incentive calculation and evaluation.

.3 The incentive will be applied when a Bidder's DVBE Participation meets or exceeds the DVBE Participation Requirement, in an attempt to displace the apparent low bidder. However, DVBE Participation of 1% or great of the value of their bid is required to qualify for the DVBE Incentive.

.4 The percentage of DVBE Incentive will be equal to percentage of a bidder's DVBE participation (rounded to the nearest two decimal places) and subject to a minimum of 1.00% and a maximum of 5.00% and will not exceed $500,000. Bids with DVBE Participation of greater than 5.00% will be calculated with a maximum of 5.00% Incentive and will not exceed $500,000.

.5 For every bidder qualifying for the DVBE incentive, the amount (dollar value) of the incentive is computed using the qualifying bidder's percentage of DVBE incentive and the lowest responsive and responsible bid price. Calculations to determine adjusted bid price are for consideration only. Bids will be awarded for the actual bid amount as verified by the State.

.6 A certified Small Business may only be displaced by another certified Small Business with a higher percentage of DVBE participation and a lower adjusted bid price.

1) A certified Small Business shall not be displaced by a non-small business.
2) When applying the DVBE Incentive program, bidders claiming the "Non-Certified Small Business preference" are considered a non-small business.

END OF DOCUMENT

REQUEST FOR BIDDING INTERPRETATION (RFBI)

(Email no later than MAY 26, 2022, 5:00 p.m.)

PMDB RFBI No.: _____
Requestor RFBI No.: _____
Request Date: _____
From (Bidder): _____

To: **Dianna C. Brown, Project Director**
Project Management and Development Branch
Real Estate Services Division
Phone: (279) 946-8626

Contact: _____
Phone: _____
Fax: _____
Email: _____

Email: Dianna.Brown@dgs.ca.gov
Angela.Ball@IBIGroup.com

All RFBIs received prior to deadline identified above, and responses from the State will be published on http://www.caleprocure.ca.gov. Click on "Start Search." In the event name field, enter the project number and click search. While viewing the Event Details, click on "View Event Package" to view RFBI responses.

Project No.: 000000000004359
Project Name: California African American Museum (CAAM) Facility Upgrade
Location: Los Angeles, CA

Drawing Reference: _____ **Project Manual Reference**: _____

Question:

Bidder's Authorized Signature: _____

[ ] Check here if additional pages attached

DOCUMENT 00 22 00

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following requirements supplement Document 00 21 00, Instructions to Bidders:

1. PAYEE DATA RECORD

   Add the following to Subarticle 6.2:

   Bidders are requested to complete and return the State's Payee Data Record form, Std.204 (and Std. 205 if applicable), included with the Bid Forms. The Payee Data Record form is required in lieu of IRS W-9 when doing business with the State of California and will be used by the State to prepare tax information returns as stated on the form.

   .1 Completion and submission of the form with the Bid Forms will expedite processing of the Award of Contract.

   .2 Failure to submit the completed form with the Bid will not be cause for rejection of a Bid.

   .3 Forms of all Bidders will be kept on file by the State for use in future awarded Contracts.

   .4 Bidders who have a completed and current Payee Data Record form on file with the Department of General Services, Real Estate Services Division, Contracts Section, may so state on the form and will not be required to submit a duplicate form.

   .5 The form is subject to Section 7(b) of the Privacy Act of 1974 (Public Law 93-5791). Refer to the Privacy Statement on the back of the form.

2. SMALL BUSINESS

   Sub-Article 5.5 is removed.

3. NON-SMALL BUSINESS

   Sub-Article 5.6 is removed.

4. PUBLIC BID OPENING

   Article 8 is removed.

5. PARTICIPATION IN DISABLED VETERANS BUSINESS ENTERPRISES (DVBE) PROGRAM

   Article 18 is removed in its entirety

6. COMPETENCE OF BIDDERS

   Add the following Subparagraph 2.1.3 to Paragraph 2.1 of Document 00 21 00, Instructions to Bidders:

   .3 Bidders' attention is directed to Business and Professions Code Sections 7026.12 and 7057(c) which require the installation of a fire protection system to be performed only by a Contractor

holding a Fire Protection specialty contractor license classification C-16. The Contractor for this Project must hold the C-16 license classification or contract directly with a first tier subcontractor with the C-16 license classification.

.

7. AWARD OF CONTRACT

   Pursuant to Article 11 of Document 00 21 00, Instructions to Bidders, award of Contract, if awarded, will be made within 16 days as specified. Award period for second and third lowest responsible bidders will similarly be extended 15 days each.

8. CONSTRUCTION PHASING PLAN & MILESTONE CONSTRAINTS

   Bidders' attention is directed to the phasing plan and milestone constraints for construction occurring within the museum gallery areas **(refer to drawings for more detail).** Construction activity in these areas **must be completed** without deviation from the phasing schedule.

END OF DOCUMENT

DOCUMENT 00 22 10

DISABLED VETERAN BUSINESS ENTERPRISE PARTICIPATION PROGRAM REQUIREMENTS

Public Contract Code Section 10115 establishes a contract participation goal of at least three percent (3%) for Disabled Veteran Business Enterprise (DVBE) for State agencies.

DVBE participation is not required for this contract. Participation goal for this project has been set at 0%. Participation above and beyond the requirement is strongly encouraged. This bid package provides information for the DVBE Participation Program. Bidders must meet DVBE Participation Program requirements to be viewed as a responsive bidder and considered for contract award.

PLEASE READ THESE INSTRUCTIONS CAREFULLY

Bidders must fully comply with DVBE Participation Program requirements. Bidders that do not submit a complete response may find their bid determined to be non-responsive and the bid rejected.

For assistance with meeting the DVBE participation program requirements, please contact:

Department of General Services
Administrative Division
Office of Business and Acquisition Services
Contract Services Section – SB-DVBE Advocate
707 Third Street, MS 508
West Sacramento, CA 95605
Email: OBASAdvocate@dgs.ca.gov

The **Office of Small Business and DVBE Services** (OSDS) offers program information and may be reached at:

Department of General Services
Office of Small Business and DVBE Services (OSDS)
707 3RD Street, 1st Floor, Room 400
West Sacramento, CA 95605-2811
Homepage: Apply for or Re-Apply for Certification as a Small Business and/or Disabled Veteran Business Enterprise
Receptionist: (916) 375-4940
FAX: (916) 375-4950
Email: OSDSHelp@dgs.ca.gov

Mailing Address:
Office of Small Business and DVBE Services (OSDS)
Room 1-400, MS 210
P.O. Box 989052
West Sacramento, CA 95798-9052

INSTRUCTIONS FOR
DVBE PARTICIPATION PROGRAM COMPLIANCE OPTIONS

If for any reason you fail to meet the DVBE Participation Requirement for this bid, your bid will be considered non-responsive.

Meet or exceed the DVBE participation requirements for the proposed contract by one of the following two (2) ways:

1. **DVBE Bidder -** If you are a DVBE bidder, agree to perform the required percentage of the contract bid amount or value with your firm or in combination with other DVBE firms. You **must** write that commitment on Article 9.2 of the Bid Form, Document 00 41 00. Instructions on how to complete this document are on that page.

2. **Non-DVBE Bidder -** If you are a non-DVBE bidder, agree to use other firms for at least the required percentage of the contract bid amount or value. You **must** write that commitment on Article 9.2 of the Bid Form, Document 00 41 00. Instructions on how to complete this document are on that page.

DVBE Certification: OSDS-DVBE certification is the only acceptable certification. To verify if a contractor is certified refer to the Cal eProcure web-site at The State of California Certifications . Bidders must provide certification verification for each participating DVBE bidder, subcontractor, and/or supplier. Applicants for DVBE certification may apply online at Apply for or Re-Apply for Certification as a Small Business and/or Disabled Veteran Business Enterprise. DVBE applicants must submit specific support documentation to the OSDS.

DVBE Bid Incentive: A DVBE Incentive will be granted to Bidders who have achieved DVBE participation of 1% or greater of the value of the bid in accordance with Section 999.5(a) and (d) of the Military and Veterans Code and California Code of Regulations 1896.98 et seq. Refer to Project Manual Document 00 21 00, Article 18.5.

Pursuant to Military and Veterans Code §999.7, the awarding department shall withhold, on a contract entered into on or after January 1, 2021, ten thousand dollars ($10,000) from the final payment, or the full final payment if less than ten thousand dollars ($10,000), until a prime contractor complies with the certification requirements of subdivision (d) of Section Military and Veterans Code §999.5. A prime contractor that fails to comply with the certification requirement shall, after notice, be allowed to cure the defect. Notwithstanding any other law, if, after at least 15 calendar days but not more than 30 calendar days from the date of notice, the prime contractor refuses to comply with the certification requirements, the awarding department shall permanently deduct ten thousand dollars ($10,000) from the final payment, or the full payment if less than ten thousand dollars ($10,000).

ANSWERS TO FREQUENTLY ASKED QUESTIONS:

The following questions are among the most frequently asked regarding DVBE requirements:

Q: ***If I am awarded the contract, am I required to use the subcontractor/supplier proposed in my bid?***

A: Yes, unless you have requested and received approval from the State for substitution. Written requests should include the person's or firm's name to be substituted, the substitution reason, the reason a non-DVBE subcontractor is proposed, if applicable and describe the business to be substituted including its business status as a sole proprietorship, partnership, corporation or other entity and the certification status of the firm, if any. See Title 2, California Code of Regulations, Section 1896.64 (c) & (d) for substitution criteria.

The request and the State's approval or disapproval is not construed as an excuse for non-compliance with any other provision of the law, including but not limited to the Subletting and Subcontracting Fair Practices Act, or any other contract requirements relating to substitution of subcontractors. Failure to adhere to at least the DVBE participation proposed by the successful Contractor may be cause for contract termination and recovery of damages under the rights and remedies due the State for default section of the contract(s) and any other penalties provided for by statute.

Q: ***Who notifies the subcontractor when an award is made?***

A: Upon award to a prime Contractor, the Awarding Department notifies listed subcontractors of their contract participation. Primes are encouraged to notify their listed subcontractors immediately after an award is made to formalize their business agreements.

Q: ***What happens to bids considered non-responsive to the DVBE Participation Program requirements?***

A: Non-responsive bids are subject to rejection. Many are rejected because of:

- Incomplete documentation
- Documentation not received by bid due date
- Mathematical error related to the percentages

Q: ***If I am a disabled veteran business enterprise, can I meet the percentage requirements as a single company?***

A: Yes.

Q: ***If my submitted bid meets the contract goal and the State decides to make multiple awards to the bid/contract, could my bid be considered non-responsive?***

A: No. The State's decision to make multiple awards will not jeopardize bid compliance.

END OF DOCUMENT

BID FORM

THE STATE OF CALIFORNIA
DEPARTMENT OF GENERAL SERVICES
REAL ESTATE SERVICES DIVISION
PROJECT MANAGEMENT AND DEVELOPMENT BRANCH

FROM: _____
(Name of Bidding Firm)

DELIVER VIA EMAIL TO: DENNIS.SCHRADER@DGS.CA.GOV **BEFORE: 2:00 P.M., June 2, 2022**

FOR: **CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM)**
CONFERENCE CENTER, STORAGE AND LIBRARY IMPROVEMENTS, RE-ROOF AND HVAC UPGRADES
CALIFORNIA AFRICAN AMEICAN MUSEUM (CAAM)
LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA
PROJECT NO. 000000000004359

Plainly mark outside of envelope with "Bid For"; followed by the above title and Project Number.

The undersigned hereby proposes and agrees to furnish all labor, materials, and equipment, and to perform all work required for the above-named Project in the manner and time prescribed in the Drawings and Project Manual, dated March 2022 and such addenda thereto as may be issued prior to bid opening date and in accordance with prevailing wage rates ascertained by the Department of Industrial Relations and set forth on the DIR web site (Prevailing Wage Requirements) for General Prevailing Wage Rates as determined by the February 2022 DIR prevailing wage published rates. The Bid Price, set forth below in clear legible figures, includes the cost of Bonds, insurance, sales tax, and every other item of expense, direct or indirect, incidental to the Bid Price.

COMPLETE WORK	For the Lump Sum of: $_____

IMPORTANT - READ BEFORE SIGNING: Bid Form must be executed in same name-style in which the bidder is licensed. Bidder bidding jointly or as a combination of several business organizations is specially cautioned that such bidder must be jointly licensed in the same form and style in which the bid is executed. If making a bid as a joint venture, each person submitting the bid shall provide the information required below with respect to his or her licensure. The undersigned Bidder certifies and agrees to provide the information and comply with the requirements contained in Articles 1 through 10 on the following pages of the Bid Form. By signing, Bidder swears under penalty of perjury that the conditions of Article 2; Article 4, Paragraph 4.2; Article 7 and Article 9, Paragraph 9.2.1 are true.

Legal Name of Bidder:_____ Federal I.D. No.: _____

Contractor's License No.: _____ License Expiration Date: _____License Classification: _____

Contractor's Public Works Registration No. (Dept. of Industrial Relations): _____

Contractor's DGS Small Business/DVBE Certification Number: _____

Business Address: _____
(Street and/or P.O. Box) (City) (State) (Zip)

E-Mail Address:_____

Business Telephone No.:_____ Facsimile No.:_____

SIGN HERE ------>_____
Signature of Bidder

_____
_____
Print Name and Title of Bidder

Executed this _____day of _____, 20_____at _____, California.

ARTICLE 1 – BIDDER'S BUSINESS IDENTIFICATION

THIS BID IS SUBMITTED BY (check one):

☐ Individual ☐ Partnership
☐ Joint Venture ☐ Corporation

_____
State in which Incorporated

NOTE: If Bidder is a corporation, the State in which incorporated shall be inserted above and the legal name of the corporation shall be set forth on Page 1, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation; if Bidder is a partnership, the true name of the firm shall be set forth on Page 1, together with the signature of a partner authorized to sign contract in behalf of the partnership; and if Bidder is an individual, that person's signature shall be placed on Page 1. If signature is by an agent, other than an officer of a corporation or a member of a partnership, a Power of Attorney must be on file with the Department prior to opening bids or submitted with the bid; otherwise, the bid will be regarded as irregular and unauthorized. If bid is submitted by partnership or joint venture, the members are:

_____

_____

ARTICLE 2 – PREFERENCES AND INCENTIVES REMOVED IN ITS ENTIRETY

ARTICLE 3 – BONDING ASSISTANCE

In the event Bidder has received assistance in obtaining bonding for this Project, Bidder shall set forth name and nature of firm providing such assistance. Should that firm be listed as subcontractor, Bidder shall set forth the percentage of contract to be performed by that subcontractor.

_____
Firm Providing Assistance and Nature of Assistance

Subcontractor: ☐ Yes ☐ No Percentage _____

ARTICLE 4 – CERTIFICATIONS - BID DEPOSITORY AND FEDERAL COURT FINDINGS

4.1 By signing this Bid Form, Bidder certifies that in preparation of this Bid Form, no bid was received by the bidder from a bid depository, which depository (as to any portion of the work) prohibits or imposes sanctions for the obtaining by bidder, or the submission to bidder by any subcontractor or vendor or supplier of goods and services, of a bid outside the bid depository. This certification shall constitute a warranty, the falsity of which shall entitle the State to pursue any remedy authorized by law, and shall include the right, at the option of the State, of declaring any contract made as a result thereof to be void.

4.2 By signing this Bid Form, Bidder swears under penalty of perjury that representations of the bid with respect to bidder's license are true and that no more than one final un-appealable finding of contempt of court by a Federal Court has been issued against the Contractor within the immediately preceding two-year period because of the Contractor's failure to comply with an order of a Federal Court which orders the Contractor to comply with an order of the National Labor Relations Board.

4.3 By signing this Bid Form, Bidder acknowledges that in in accordance with the provisions of Section 3700 of the Labor Code, every contractor will be required to secure the payment of compensation to his employees. The Bidder agrees that they are aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and will comply with such provisions before commencing the performance of the work of this contract.

4.4 By signing this Bid Form, Bidder certifies they will not ask an applicant for onsite construction-related employment to disclose orally or in writing information concerning the conviction history of the applicant on or at the time of an initial employment application.

This section shall not apply to a position for which the person or the state is otherwise required by state or federal law to conduct a conviction history background check or to any contract position with a criminal justice agency, as that term is defined in Section 13101 of the Penal Code.

This section shall not apply to a person to the extent that he or she obtains workers from a hiring hall pursuant to a bona fide

collective bargaining agreement.

ARTICLE 5 – STATEMENT OF COMPLIANCE - NONDISCRIMINATION

Bidder (hereinafter referred to as "prospective contractor" in this Statement), by signing this Bid Form, hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f), and CCR, Title 2, Division 4.1, Chapter 5 and Subchapter 5, Section 11102, in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program; as set forth in the General Conditions of the Contract for Construction. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicants for employment because of sex, race, color, ancestry, religious creed, national origin, physical disability (including HIV and AIDS), medical disability (cancer), age (over 40), marital status, and denial of family care leave.

ARTICLE 6 – QUESTIONNAIRE

6.1 In accordance with Public Contract Code, Section 10162, the Bidder shall complete the following questionnaire:

6.1.1 Has the Bidder, any officer of the Bidder, or any employee of the Bidder who has a proprietary interest in the Bidder, ever been disqualified, removed, or otherwise prevented from bidding on, or completing a Federal, State or Local government project because of a violation of law or a safety regulation?

☐ Yes ☐ No

6.1.2 Has the Bidder, any officer of the Bidder, or any employee of the Bidder who has a proprietary interest in the Bidder, ever received a safety violation or failed to file notifications to the Cal-OSHA, Federal OSHA, or EPA Agencies for employee records as required by CCR, Title 8, Section 5208 and CFR 40, Part 61?

☐ Yes ☐ No

If the answer to either 6.1.1 or 6.1.2 above is “Yes”, then give the date(s) of the citation(s) or failure to make notifications, and explain the circumstances by attachment to this Bid Form.

ARTICLE 7 – NON-COLLUSION DECLARATION TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

By signing this Bid Form, Bidder, being first duly sworn, deposes and says that he or she is the authorized representative of the Bidder, the party making the foregoing bid, that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and is not collusive or sham; that the Bidder has not directly or indirectly induced or solicited any other Bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any Bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the Bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the Bidder or any other Bidder, or to fix any overhead, profit, or cost element of the bid price, or that of any other Bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the Bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

ARTICLE 8 – ADDENDA

In submitting this bid, Bidder represents that Bidder has examined copies of all the Contract Documents and acknowledges receipt of the following addenda:

Addendum No.: _____ Date: _____ Addendum No.:_____ Date: _____

Addendum No.: _____ Date: _____ Addendum No.:_____ Date: _____

Addendum No.: _____ Date: _____ Addendum No.:_____ Date: _____

Failure to acknowledge on the Bid Form receipt of an addendum shall not in itself be cause for withdrawal or rejection of bids, if it can be shown that bidder did, in fact, receive such addendum prior to bid opening.

ARTICLE 9 – DVBE COMPLIANCE & PARTICIPATION SUMMARY REMOVED IN ITS ENTIRETY

NAME OF BIDDER: _____

ARTICLE 10 – LIST OF PROPOSED SUBCONTRACTORS

Listed hereinafter are the **name**, **location, license number, and registration number** of all subcontractors who will be employed, and the **kind of work** which each will perform if the contract is awarded to the undersigned. I understand that under Public Contract Code Section 4100, et. seq., I must here clearly set forth the name and location of each subcontractor who will perform work or labor or render service to me in or about the construction of the work in an amount in excess of one-half of one percent (1/2 of 1%), of my total bid, and that as to any work in which I fail to do so, I agree to perform that portion myself or be subject to penalty under the act. (Note: In case more than one subcontractor is named for the same kind of work, state the portion that each will perform.) I also understand that listed subcontractors must be registered with the Department of Industrial Relations in order to be listed for and to engage in the performance of work on Public Works projects. Notwithstanding General Conditions Paragraph 1.1, the definition of a **SUBCONTRACTOR** for the purposes of the Subletting and Subcontracting law is as follows: A trade Contractor who is licensed with the Contractors' State License Board with an A, B, C or D classification, as defined pursuant to PCC Section 4113.

- Vendors or suppliers of materials only need not be listed.
- Any DVBE subcontractor performing work in excess of ½ of 1% of the bid amount **MUST** be listed below **AND** under ARTICLE 9.2.1 - DVBE PARTICIPATION SUMMARY.
- C-16 subcontractors must contract directly with the prime contractor and must be first tier subcontractors. If a C-16 subcontract is for more than 1/2 of 1% of the total bid, it must be listed below.

Failure to list Kind of Work, Name, Location or License Number shall cause the bid to be rejected as non-responsive.

Kind of Work	Name	Location (City)	CSLB License No.	DIR Registration No.

If further space is required below, copy this page and attached hereto to be made a part of the Bid Form. Sub List Page _____of _____

STATE OF CALIFORNIA — DEPARTMENT OF GENERAL SERVICES

CALIFORNIA CIVIL RIGHTS LAWS ATTACHMENT — OFFICE OF LEGAL SERVICES

DGSOLS 04 (Rev. 01/17)

Pursuant to Public Contract Code section 2010, a person that submits a bid or proposal to, or otherwise proposes to enter into or renew a contract with, a state agency with respect to any contract in the amount of $100,000 or above shall certify, under penalty of perjury, at the time the bid or proposal is submitted or the contract is renewed, all of the following:

1. CALIFORNIA CIVIL RIGHTS LAWS: For contracts executed or renewed after January 1, 2017, the contractor certifies compliance with the Unruh Civil Rights Act (Section 51 of the Civil Code) and the Fair Employment and Housing Act (Section 12960 of the Government Code); and

2. EMPLOYER DISCRIMINATORY POLICIES: For contracts executed or renewed after January 1, 2017, if a Contractor has an internal policy against a sovereign nation or peoples recognized by the United States government, the Contractor certifies that such policies are not used in violation of the Unruh Civil Rights Act (Section 51 of the Civil Code) or the Fair Employment and Housing Act (Section 12960 of the Government Code).

CERTIFICATION

I, the official named below, certify under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Proposer/Bidder Firm Name (Printed)	Federal ID Number
By (Authorized Signature)	

Printed Name and Title of Person Signing

Executed in the County of	Executed in the State of

Date Executed

NONCOLLUSION DECLARATION TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

The undersigned declares:
I am the _____ of _____, the party making the foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____ [date], at _____ [city], _____ [state]."

_____
Signed

END OF DOCUMENT

BIDDER'S BOND

STATE OF CALIFORNIA

DEPARTMENT OF GENERAL SERVICES

KNOW ALL MEN BY THESE PRESENTS:

That we,

_____

_____, as Principal,

and _____

_____

as Surety, are held and firmly bound unto the State of California, hereinafter called the State, in the penal sum of ten percent (10%) of the total amount of the bid of the Principal above named, submitted by said Principal to the State of California, Department of General Services, for the work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION of this obligation is such that:

WHEREAS, the Principal has submitted the above-mentioned bid to the State of California, Department of General Services, for certain construction specifically described as follows, for which bids are to be opened at _____

_____ *(Insert place where bids will be opened)* on _____ *(Insert date of bid opening)*

for _____

(Copy here the exact description of work, including location, as it appears on the proposal)

NOW, THEREFORE, If the aforesaid Principal is awarded the contract and, within the time and manner required under the specifications, after the prescribed forms are presented to him for signature, enters into a written contract, in the prescribed form, in accordance with the bid, and files the two bonds with the Department, one to guarantee faithful performance and the other to guarantee payment for labor and materials, as required by law, then this obligation shall be null and void; otherwise, it shall be and remain in full force and virtue.

In the event suit is brought upon this bond by the Obligee and judgment is recovered, the Surety shall pay all costs incurred by the Obligee in such suit, including a reasonable attorney's fee to be fixed by the court.

IN WITNESS WHEREOF, We have hereunto set our hands and seals on this _____ day of _____, 20____.

_____ (SEAL)

_____ (SEAL)

_____ (SEAL)

Name of Principal and Address for Service

By_____

Contractor Signature

_____ (SEAL)

_____ (SEAL)

_____ (SEAL)

Name of Surety and Address for Service

By_____

Attorney-in-Fact Signature

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

NOTE: Signatures of those executing for the Surety must be properly acknowledged.

CERTIFICATE OF ACKNOWLEDGMENT

STATE OF CALIFORNIA

COUNTY OF _____ ss

On this _____ day of _____ in the year of 20___ before me, a notary public in and for the county and state aforesaid, personally appeared, _____ and proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and proved to me on the basis of satisfactory evidence to be the attorney-in-fact of _____ and acknowledged to me that he/she subscribed the name of the said company thereto as surety, and his/her own name as attorney-in-fact.

(SEAL)

_____

Notary Public

STATE OF CALIFORNIA – DEPARTMENT OF FINANCE

PAYEE DATA RECORD

(Required when receiving payment from the State of California in lieu of IRS W-9 or W-7)

STD 204 (Rev. 03/2021)

Section 1 – Payee Information

NAME (This is required. Do not leave this line blank. Must match the payee's federal tax return)

BUSINESS NAME, DBA NAME or DISREGARDED SINGLE MEMBER LLC NAME (if different from above)

MAILING ADDRESS (number, street, apt. or suite no.) (See instructions on Page 2)

CITY, STATE, ZIP CODE	E-MAIL ADDRESS

Section 2 – Entity Type

Check one (1) box only that matches the entity type of the Payee listed in Section 1 above. (See instructions on page 2)

- ☐ **SOLE PROPRIETOR / INDIVIDUAL**
- ☐ **SINGLE MEMBER LLC** *Disregarded Entity owned by an Individual*
- ☐ **PARTNERSHIP**
- ☐ **ESTATE OR TRUST**

CORPORATION (see instructions on page 2)

- ☐ **MEDICAL** *(e.g., dentistry, chiropractic, etc.)*
- ☐ **LEGAL** *(e.g., attorney services)*
- ☐ **EXEMPT** *(e.g., nonprofit)*
- ☐ **ALL OTHERS**

Section 3 – Tax Identification Number

Enter your Tax Identification Number (TIN) in the appropriate box. The TIN must **match** the name given in Section 1 of this form. Do not provide more than one (1) TIN. The TIN is a 9-digit number. **Note:** Payment will not be processed without a TIN.

- For **Individuals**, enter SSN.
- If you are a **Resident Alien**, and you do not have and are not eligible to get an SSN, enter your ITIN.
- Grantor Trusts (such as a Revocable Living Trust while the grantors are alive) may not have a separate FEIN. Those trusts must enter the individual grantor's SSN.
- For **Sole Proprietor or Single Member LLC (disregarded entity), in which the sole member is an individual**, enter SSN (ITIN if applicable) or FEIN (FTB prefers SSN).
- For **Single Member LLC (disregarded entity), in which the sole member is a business entity**, enter the owner entity's FEIN. Do not use the disregarded entity's FEIN.
- For all other entities including LLC that is taxed as a corporation or partnership, estates/trusts (with FEINs), enter the entity's FEIN.

Social Security Number (SSN) or Individual Tax Identification Number (ITIN)

___ ___ ___ - ___ ___ - ___ ___ ___ ___

OR

Federal Employer Identification Number (FEIN)

___ ___ - ___ ___ ___ ___ ___ ___ ___

Section 4 – Payee Residency Status (See instructions)

☐ **CALIFORNIA RESIDENT** – Qualified to do business in California or maintains a permanent place of business in California.

☐ **CALIFORNIA NONRESIDENT** – Payments to nonresidents for services may be subject to state income tax withholding.

- ☐ No services performed in California
- ☐ Copy of Franchise Tax Board waiver of state withholding is attached.

Section 5 – Certification

I hereby certify under penalty of perjury that the information provided on this document is true and correct. Should my residency status change, I will promptly notify the state agency below.

NAME OF AUTHORIZED PAYEE REPRESENTATIVE	TITLE	E-MAIL ADDRESS

SIGNATURE	DATE	TELEPHONE *(Include area code)*

Section 6 – Paying State Agency

Please return completed form to:

STATE AGENCY/DEPARTMENT OFFICE	UNIT/SECTION	
Department of General Services, Administrative Division	Office of Business and Acquisition Services, Contract Services Section	
MAILING ADDRESS 707 Third Street, MS 508	**FAX** n/a	**TELEPHONE** *(Include area code)* n/a

CITY	STATE	ZIP CODE	E-MAIL ADDRESS
West Sacramento	CA	95605	n/a

STATE OF CALIFORNIA – DEPARTMENT OF FINANCE

PAYEE DATA RECORD

(Required when receiving payment from the State of California in lieu of IRS W-9 or W-7)

STD 204 (Rev. 03/2021)

GENERAL INSTRUCTIONS

Type or print the information on the Payee Data Record, STD 204 form. Sign, date, and return to the state agency/department office address shown in Section 6. Prompt return of this fully completed form will prevent delays when processing payments.

Information provided in this form will be used by California state agencies/departments to prepare Information Returns (Form 1099).
NOTE: Completion of this form is optional for Government entities, i.e. federal, state, local, and special districts.

A completed Payee Data Record, STD 204 form, is required for all payees (non-governmental entities or individuals) entering into a transaction that may lead to a payment from the state. Each state agency requires a completed, signed, and dated STD 204 on file; therefore, it is possible for you to receive this form from multiple state agencies with which you do business.

Payees who do not wish to complete the STD 204 may elect not to do business with the state. If the payee does not complete the STD 204 and the required payee data is not otherwise provided, payment may be reduced for federal and state backup withholding. Amounts reported on Information Returns (Form 1099) are in accordance with the Internal Revenue Code (IRC) and the California Revenue and Taxation Code (R&TC).

Section 1 – Payee Information

Name – Enter the name that appears on the payee's federal tax return. The name provided shall be the tax liable party and is subject to IRS TIN matching (when applicable).

- Sole Proprietor/Individual/Revocable Trusts – enter the name shown on your federal tax return.
- Single Member Limited Liability Companies (LLCs) that is disregarded as an entity separate from its owner for federal tax purposes - enter the name of the individual or business entity that is tax liable for the business in section 1. Enter the DBA, LLC name, trade, or fictitious name under Business Name.
- Note: for the State of California tax purposes, a Single Member LLC is not disregarded from its owner, even if they may be disregarded at the Federal level.
- Partnerships, Estates/Trusts, or Corporations – enter the entity name as shown on the entity's federal tax return. The name provided in Section 1 must match to the TIN provided in section 3. Enter any DBA, trade, or fictitious business names under Business Name.

Business Name – Enter the business name, DBA name, trade or fictitious name, or disregarded LLC name.

Mailing Address – The mailing address is the address where the payee will receive information returns. Use form STD 205, Payee Data Record Supplement to provide a remittance address if different from the mailing address for information returns, or make subsequent changes to the remittance address.

Section 2 – Entity Type

If the Payee in Section 1 is a(n)...	THEN Select the Box for...
Individual • Sole Proprietorship • Grantor (Revocable Living) Trust disregarded for federal tax purposes	Sole Proprietor/Individual
Limited Liability Company (LLC) owned by an individual and is disregarded for federal tax purposes	Single Member LLC-owned by an Individual
Partnerships • Limited Liability Partnerships (LLP) • and, LLC treated as a Partnership	Partnerships
Estate • Trust (other than disregarded Grantor Trust)	Estate or Trust
Corporation that is medical in nature (e.g., medical and healthcare services, physician care, nursery care, dentistry, etc. • LLC that is to be taxed like a Corporation and is medical in nature	Corporation-Medical
Corporation that is legal in nature (e.g., services of attorneys, arbitrators, notary publics involving legal or law related matters, etc.) • LLC that is to be taxed like a Corporation and is legal in nature	Corporation-Legal
Corporation that qualifies for an Exempt status, including 501(c) 3 and domestic non-profit corporations.	Corporation-Exempt
Corporation that does not meet the qualifications of any of the other corporation types listed above • LLC that is to be taxed as a Corporation and does not meet any of the other corporation types listed above	Corporation-All Other

Section 3 – Tax Identification Number

The State of California requires that all parties entering into business transactions that may lead to payment(s) from the state provide their Taxpayer Identification Number (TIN). The TIN is required by R&TC sections 18646 and 18661 to facilitate tax compliance enforcement activities and preparation of Form 1099 and other information returns as required by the IRC section 6109(a) and R&TC section 18662 and its regulations.

Section 4 – Payee Residency Status

Are you a California resident or nonresident?

- A corporation will be defined as a "resident" if it has a permanent place of business in California or is qualified through the Secretary of State to do business in California.
- A partnership is considered a resident partnership if it has a permanent place of business in California.
- An estate is a resident if the decedent was a California resident at time of death.
- A trust is a resident if at least one trustee is a California resident.

For individuals and sole proprietors, the term "resident" includes every individual who is in California for other than a temporary or transitory purpose and any individual domiciled in California who is absent for a temporary or transitory purpose. Generally, an individual who comes to California for a purpose that will extend over a long or indefinite period will be considered a resident. However, an individual who comes to perform a particular contract of short duration will be considered a nonresident.

For information on Nonresident Withholding, contact the Franchise Tax Board at the numbers listed below:

Withholding Services and Compliance Section: 1-888-792-4900 E-mail address: wscs.gen@ftb.ca.gov
For hearing impaired with TDD, call: 1-800-822-6268 Website: www.ftb.ca.gov

Section 5 – Certification

Provide the name, title, email address, signature, and telephone number of individual completing this form and date completed. In the event that a SSN or ITIN is provided, the individual identified as the tax liable party must certify the form. Note: the signee may differ from the tax liable party in this situation if the signee can provide a power of attorney documented for the individual.

Section 6 – Paying State Agency

This section must be completed by the state agency/department requesting the STD 204.

Privacy Statement

Section 7(b) of the Privacy Act of 1974 (Public Law 93-579) requires that any federal, state, or local governmental agency, which requests an individual to disclose their social security account number, shall inform that individual whether that disclosure is mandatory or voluntary, by which statutory or other authority such number is solicited, and what uses will be made of it. It is mandatory to furnish the information requested. Federal law requires that payment for which the requested information is not provided is subject to federal backup withholding and state law imposes noncompliance penalties of up to $20,000. You have the right to access records containing your personal information, such as your SSN. To exercise that right, please contact the business services unit or the accounts payable unit of the state agency(ies) with which you transact that business.

All questions should be referred to the requesting state agency listed on the bottom front of this form.

STATE OF CALIFORNIA – DEPARTMENT OF GENERAL SERVICES

STANDARD AGREEMENT

STD 213 (Rev. 03/2019)

AGREEMENT NUMBER	PURCHASING AUTHORITY NUMBER (if applicable)

1. This Agreement is entered into between the Contracting Agency and the Contractor named below:

CONTRACTING AGENCY NAME

Department of General Services, Real Estate Services Division, Project Management and Development Branch

CONTRACTOR NAME

2.The Term of this Agreement is:

START DATE

As Identified in the Notice to Proceed

THROUGH END DATE

XXX Calendar Days, commencing on the Start Date Identified in the Notice to Proceed

3.The maximum amount of this Agreement is: $X,XXX,XXX.XX

4. The parties agree to comply with the terms and conditions of the following exhibits, which are by this reference made a part of the Agreement.

EXHIBITS	TITLE	PAGES
Project Title	Project Title Client Address City, County, CA Project Number	
Exhibit A	Performance Bond, Payment Bond, Bid Form, and Invitation to Bid	
Exhibit B	Project Manual (except Bidding Requirements), dated XXX including the following Contract Documents: Introductory Information General Conditions of the Contract for Construction Supplementary Conditions Specifications Addenda No.	
Exhibit C	XXX Drawings, dated XXX, as listed in Document 00 01 15 of the Project Manual	

Items shown with an asterisk (*), are here by incorporated by reference and made part of this agreement as if attached hereto. These documents can be viewed at https://www.dgs.ca.gov/ols/resources

IN WITNESS WHEREOF, THIS AGREEMENT HAS BEEN EXECUTED BY THE PARTIES HERETO.

CONTRACTOR

CONTRACTOR NAME (if other than an individual, state whether a corporation, partnership, etc.)

CONTRACTOR BUSINESS ADDRESS	CITY	STATE	ZIP

PRINTED NAME OF PERSON SIGNING	TITLE

CONTRACTOR AUTHORIZED SIGNATURE	DATE SIGNED

STATE OF CALIFORNIA

CONTRACTING AGENCY NAME

CONTRACTING AGENCY ADDRESS	CITY	STATE	ZIP

PRINTED NAME OF PERSON SIGNING	TITLE

CONTRACTOR AUTHORIZED SIGNATURE	DATE SIGNED

CALIFORNIA DEPARTMENT OF GENERAL SERVICES APPROVAL	EXEMPTION, IF APPLICABLE

PERFORMANCE BOND TO ACCOMPANY CONSTRUCTION CONTRACT

KNOW ALL MEN BY THESE PRESENTS:

THAT WHEREAS, The State of California, acting by and through the Department of General Services has awarded to _____, a _____ existing under and by virtue of the laws of the State of California as Contractor, a contract for the work described as follows:

Project Name
Client Agency
Project Information
Reference Number, Project Number, Contract Number

AND WHEREAS, Said Contractor is required to furnish a bond in connection with said contract, guaranteeing the faithful performance thereof;

NOW, THEREFORE, We the undersigned Contractor and surety are held and firmly bound unto the State of California in the sum of _____ Dollars, ($000,000) to be paid to the State or its certain attorney, its successors and assigns; for which payment well and truly to be made we bind ourselves, our heirs, executors and administrators, successors and assigns, jointly and severally firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH,

That if the above bounded Contractor, his or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the foregoing contract and any alteration thereof made as therein provided, on his or their part to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless the State of California, its officers and agents, as therein stipulated, then this obligation shall become and be null and void; otherwise it shall be and remain in full force and virtue.

IN WITNESS WHEREOF, We have hereunto set our hands and seals on this _____ day of _____, 20_____

_____

_____
Name of Contractor and Address for Service

By_____
Contractor Signature

_____

_____

_____ (SEAL)
Name of Surety and Address for Service

By _____
Attorney-in-Fact Signature

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

CERTIFICATE OF ACKNOWLEDGMENT

STATE OF CALIFORNIA
COUNTY OF _____ ss

On this _____ day of _____ in the year of 20____ before me, a notary public in and for the county and state aforesaid, personally appeared, _____ proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and proved to me on the basis of satisfactory evidence to be the attorney-in-fact of _____ and acknowledged to me that he/she subscribed the name of the said company thereto as surety, and his/her own name as attorney-in-fact.

(SEAL)

_____
NOTARY PUBLIC

PAYMENT BOND TO ACCOMPANY CONSTRUCTION CONTRACT

(Public Contract Code Sections 7103 and 10221)

BOND NO._____

The premium on this bond is _____ for the term of Agreement Number 20-XXXX

Know All Men By These Presents:

That the State of California, acting by and through the Department of General Services, has awarded to _____ whose address for service is _____, as Principal, a contract for the work described as follows:

Project Title: _____

Project Location: _____

WHEREAS, the provisions of Public Contract Code Sections 7103 and 10221 require that the Principal file a bond in connection with said contract and this bond is executed and tendered in accordance therewith.

NOW THEREFORE, Principal and _____, a Surety Corporation organized under the laws of _____, and authorized to transact a general surety business is in the State of California, as Surety, are held and firmly bound to the People of the State of California in the penal sum of _____, for which payment we bind ourselves, our heirs, executors, administrators, successors and assigns jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH,

1. That if said Principal or its subcontractors shall fail to pay any of the persons named in Civil Code Section 9100, or amounts due under the Unemployment Insurance Code with respect to work or labor performed under the contract, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Principal and subcontractors pursuant to Section 13020 of the Unemployment Insurance Code, with respect to such work and labor, that the surety herein will pay for the same, otherwise this obligation is to be void. In case suit is brought upon this bond, the Surety will pay a reasonable attorney's fee to be fixed by the court.
2. This bond shall inure to the benefit of any persons named in Civil Code Section 9100 as to give a right of action to such persons or their assigned in any suit brought upon this bond.
3. The aggregate liability of the Surety hereunder, including costs and attorney fees, on all claims whatsoever shall not exceed the penal sum of the bond in accordance with the provisions of Section 996.470(a) of the Code of Civil Procedure.
4. This bond is executed by the Surety, to comply with the provisions of Public Contract Code Sections 7103, 10221 and 10222, of Chapter 5, Title 3, Part 6, Division 4 of the Civil Code and of Chapter 2, Title 14, Part 2 of the Code of Civil Procedure and said bond shall be subject to all of the terms and provisions thereof.
5. This bond may be cancelled by the Surety in accordance with the provisions of Section 996.310 et seq. of the Code of Civil Procedure.
6. This bond to become effective _____

_____ _____

(NAME OF SURETY) (ADDRESS FOR SERVICE)

I certify (or declare) under penalty of perjury under the laws of the State of California that I have executed the foregoing bond under an unrevoked power of attorney.

Executed in _____ on _____

(CITY AND STATE) (DATE)

X _____

(SIGNATURE OF ATTORNEY IN FACT)

_____

(PRINTED OR TYPED NAME OR ATTORNEY IN FACT)

STATE OF

CALIFORNIA Std. 807

(Rev. 10/2019)

Department of General Services

Change Order

Date Issued: (Type Date)

Change Order No: _____

ABMS Contract No: _____
F$ Contract No.: _____
Project ID: **DGS000000XXXXXX**
Activity ID: **CN**
Resource Type: **CONTR**
Category: **10000**

From Division: **Real Estate Services Division**
Branch: **Project Management and Development Branch**
Address: **707 Third Street, 4th Floor**
City, State Zip: **West Sacramento, CA 95605**

Revision No.: _____
Date Revised: _____

Project: _____
Client Agency: _____
Facility Name: _____
Facility Location: _____

To: (Contractor's Name:)
(Contractor's Address:)
(Contractor's City/State/Zip:)

This Change Order is issued pursuant to the provisions of the General Conditions Article 6 of the Contract relating to **Changes in the Work** and shall not be effective until approved by the Department of General Services, REAL ESTATE SERVICES DIVISION. The State will issue the change order after the conditions have been agreed to. The contractor is directed to proceed with construction activities in such manner as to preclude the necessity for later altering the work in order to accomplish this change. This document must be completed in every detail, signed, dated and returned in **DUPLICATE** to the State's representative within **fifteen (15)** calendar days from the date of issue, as provided in the General Conditions of the Contract. Upon approval, a signed copy will be sent to the contractor as authority for proceeding with the changes (or as confirmation of previously issued instructions).

Change Order Description

Item #	Description	Amount

Total this Change Order $100,000.00

The Undersigned Contractor agrees to make this change in accordance with the printed conditions herein for
The Additive sum of $ or deductive sum ($).

This change is approved for the sum stated above and for a time extension of _____ calendar days.

This Agreement constitutes full and final settlement for all aspects of the work described herein. As part of this agreement, Contractor waives any and all rights to claim for any delay or impact costs associated with the work described herein, including, but not limited to, inefficiency, unabsorbed and extended home office overhead and extended field office overhead.

Authorized Contractor's Signature	Title	Date

Authorized State's Representative Signature	Title	Date

Distribution of Change Order:
Originals to: 1) Contractor 2) RESD Contract Unit
Copies to: 1) Project Manager 2) State Controllers Office 3) DGS Capital Outlay Account 4) State Inspector

STATE OF CALIFORNIA DEPARTMENT OF GENERAL SERVICES REAL ESTATE SERVICES DIVISION

Document 00 72 00

General Conditions of the Contract for Construction

October 2011 Edition

Table of Articles

DOCUMENT 00 72 00 - GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE 1 - GENERAL PROVISIONS

1.1 **DEFINITIONS:** When the following terms appear in the Contract, they shall have the following meaning:

1.1.1 Acceptance of the Work: Written acceptance of the Work by the Director of the Department of General Services, State of California, or the Director's designee.

1.1.2 Act of God: An Act of God shall include only the following occurrences or conditions and effects:

.1 Earthquakes in excess of a magnitude of 3.5 on the Richter Scale; or
.2 Tidal waves.

1.1.3 Addendum (Addenda): A document issued by the State during the bidding period which modifies, supersedes or supplements the Contract Documents.

1.1.4 Alternative: Refer to Approved Equal and Substitution.

1.1.5 Applicable Codes: Include, but are not limited to, applicable laws, statutes, regulations, rules, building and other codes, ordinances, rulings, and lawful orders of all public authorities having jurisdiction over the State, the Contractor, Subcontractors, the Project, the Work, or the execution of the Work.

1.1.6 Approved Equal: Material, equipment, or method approved by the State for use in the Work, as being acceptable as an equivalent in essential attributes to the material, equipment, or method specified in the Contract Documents.

1.1.7 Agreement: The written and executed document known as Document 00 52 00, Agreement.

1.1.8 Architect or Engineer: The State, or the State's consultant listed in the Contract Documents as the designer of record responsible for the preparation and coordination of the Drawings and technical sections of the Project Manual.

1.1.9 Beneficial Occupancy: Occupancy and use by the State of all, or part, or parts, of the Work as selected by the State, prior to Completion.

1.1.10 Bidder: Any individual, partnership, corporation, association, joint venture, or any combination thereof, submitting a Bid Form for the Work.

1.1.11 Change Order: A written order issued by the State used to determine adjustments in the Contract based on:

.1 a change in the Work,
.2 the amount of the adjustment in the Contract Sum, and
.3 the extent of the adjustment in the Contract Time.

1.1.12 Claim: An unresolved Dispute arising under or relating to the performance of the Contract which can only be filed after Acceptance of the Work and the final statement to the Contractor.

1.1.13 Completion: When the entire Work has been performed in accordance with the Contract requirements as delineated in the Contract Documents and Project Manual. Completion of the Work occurs when the State's final inspection has been made and all construction, services and deliverables have been fully executed as determined by the State's Representative, including but not limited to completion of all punch-list items and delivery of as-built drawings, operation & maintenance manuals, guaranties, warranties, spare parts, reports and certifications as noted in the Project Manual, Section 01 77 00.

1.1.14 Contract: The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified by a Change Order. The Contract Documents shall not be construed to create a contractual relationship of any kind between any persons or entities other than the State and the Contractor.

1.1.15 Contract Documents: The Contract Documents consist of the Agreement between the State and Contractor, Payment and Performance Bonds; the Conditions of the Contract, including General, Supplementary and other Conditions; Drawings, Specifications, Addenda and Change Orders.

1.1.16 Contract Sum: The Contract Sum is stated in the Agreement and, including authorized adjustments by Change Order, is the total amount payable by the State to the Contractor for performance of the Work under the Contract Documents.

1.1.17 Contract Time: The Contract Time is the period of time, from the Start Date to the date of Completion of the Work, including authorized adjustments, allotted in the Contract.

1.1.18 Contractor: The individual, partnership, corporation, association, joint venture, or any combination thereof, who has entered into a contract with the State, identified as such in the Agreement, and referred to throughout the Contract as if singular in number. The term "Contractor" means the Contractor or the Contractor's representative.

1.1.19 Day: Calendar day, unless otherwise specifically defined.

1.1.20 Department: The Department of General Services, State of California.

1.1.21 Director: The Director of the Department of General Services, State of California, or the Director's designee.

1.1.22 Dispute: A demand during performance of the Work seeking adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. A Dispute is not a Claim.

1.1.23 Drawings: The graphic and pictorial portions of the Contract Documents, illustrating the design, location and dimensions of the Work, generally including but not limited to, plans, elevations, sections, details, schedules and diagrams.

1.1.24 Emergency: A sudden, unexpected occurrence that poses a clear and imminent danger, requiring immediate action to prevent or mitigate the loss or impairment of life, health, property, or essential public services.

1.1.25 General Notes: The written instructions, provisions, conditions or other requirements appearing on the Drawings, and so identified thereon, which pertain to the performance of the Work.

1.1.26 Guarantee: The Contractor's assurance that the Project complies with the requirements of the Contract Documents.

1.1.27 Official Progress Schedule: The Contractor's baseline schedule and updates accepted by the State.

1.1.28 Or Equal: Refer to Approved Equal.

1.1.29 Owner: The State of California.

1.1.30 Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

1.1.31 Project: The total construction of which the Work performed under the Contract may be the whole or a part.

1.1.32 Project Manual: The volume(s) assembled for the Work which includes the Introductory Information, Bidding Requirements, Contracting Requirements, Specifications, and other information as may be listed in the Project Manual Table of Contents.

1.1.33 Request for Information (RFI): A written request by the Contractor submitted in a State provided format for information regarding Project specific issues.

1.1.34 Retention: A percentage of the Contract Sum held back upon completion of the Work, or any portion of the Work, to cover outstanding liabilities, contingencies, and the like, as specified in the Contract Documents.

1.1.35 Samples: Physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

1.1.36 Schedule of Values: A document furnished by the Contractor to the State reflecting the portions of the Contract sum allotted for the various parts of the Work, and used as the basis for reviewing the Contractor's applications for payment request.

1.1.37 Shop Drawings: Drawings, diagrams, schedules, and other data specially issued for the Work by the Contractor or a Subcontractor, Sub-subcontractor, and material suppliers to illustrate some portion of the Work.

1.1.38 Specifications: That portion of the Contract Documents consisting of the written requirements for materials, standards, equipment, construction systems, and standards of workmanship for the Work, and performance of related services.

1.1.39 State: The State of California acting through the Department of General Services.

1.1.40 State Construction Supervisor/Inspector: The person(s) authorized by the State to provide inspection services, field coordination and quality control during construction.

1.1.41 State Contract Act: The act which is set forth in the California Public Contract Code, Section 10100, et seq.

1.1.42 State's Representative: Person(s) authorized by the State to act on behalf of the State for the Project.

1.1.43 Subcontractor: An individual, partnership, corporation, association, joint venture, or any combination thereof, who has a direct contract with the Contractor to perform work or labor or render service in or about the Work. The term "Subcontractor" is referred to as if singular in number and means a Subcontractor or a representative of the Subcontractor. The term "Subcontractor" shall not include those who supply materials only or a separate contractor or subcontractors of a separate contractor.

1.1.44 Sub-subcontractor: A person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the work. The term "Sub-subcontractor" is referred to as if singular in number and means a Sub-subcontractor or a representative of the Sub-subcontractor.

1.1.45 Not Used

1.1.46 Substitution: A material and/or process offered by the Contractor in lieu of the specified material and/or process, and accepted by the State in writing as being equivalent (equal) to the specified material and/or process.

1.1.47 Warranty: A Contractor's, manufacturer's or material supplier's assurance that products and services provided meet the requirements of the Contract Documents.

1.1.48 Work: Construction, services and deliverables required by the Contract Documents and Project Manual, including labor, materials, equipment, services, and documents provided or to be provided by the Contractor to fulfill the Contractor’s obligations under the Contract, including but not limited to requirements such as; completion of punch-list items, as-built drawings, operation & maintenance manuals, guaranties, warranties, spare parts, reports, and certifications.

1.2 EXECUTION, CORRELATION AND INTENT

1.2.1 The Contract will not be binding on the State until appropriately endorsed by the State's legal Representative, in accordance with Public Contract Code, Section 10220.

1.2.2 Execution of the Contract by the Contractor is a representation that the Contractor is familiar with the methodology under which the work is to be performed and has correlated personal observations with requirements of the Contract Documents.

1.2.3 The intent of the Contract Documents is to include items necessary for completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.4 Organization of the Specifications into Groups, Divisions, subgroups, Sections and Articles, and arrangement of Drawings shall not be the basis that Contractor utilizes in dividing the Work among Subcontractors, nor in establishing the extent of work to be performed by any trade.

1.2.5 When standards of the Federal Government, trade societies, or trade associations are referred to in the Contract Documents by specific date of issue, these shall be considered as part of the Contract Documents. When such references do not bear date of issue, current published edition at the date of the first Invitation to Bid shall be considered as part of the Contract Documents.

1.2.6 Unless otherwise stated in the Contract Documents, words and terms which have well-known or commonly accepted technical or construction industry meanings shall be used in the Contract Documents in accordance with such recognized meanings.

1.2.7 Every part of the Work shall be accomplished in workmanship-like manner by workers, laborers, or mechanics specially skilled in the class of work required. Any person the State may deem incompetent or disorderly shall be promptly removed from the Project by the Contractor upon written notice from the State, and shall not be re-employed on this Project.

1.3 **USE OF THE STATE'S DRAWINGS, PROJECT MANUAL AND OTHER DOCUMENTS:** The Drawings, Project Manual and other documents issued by the State, and copies furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects, nor for additions to this Project outside the scope of the Work without the specific written consent of the State. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are granted a limited license to use and reproduce applicable portions of the Drawings, Project Manual and other documents issued by the State appropriate to, and for use in, the execution of their work under the requirements of the Contract Documents.

1.4 **CAPITALIZATION**

1.4.1 Terms capitalized in the General Conditions of the Contract for Construction include those which are:

.1 Specifically defined; or
.2 Titles of numbered Articles; or
.3 References to Paragraphs, Subparagraphs and Clauses; or
.4 Titles of other documents.

1.5 **CONFLICTS IN THE CONTRACT DOCUMENTS**

1.5.1 In the event of conflict in the Contract Documents, the following priorities shall govern:

.1 Addenda shall govern over other Sections of the Contract Documents to the extent specifically noted; subsequent Addenda shall govern over prior Addenda only to the extent specified.
.2 The General Conditions of the Contract for Construction shall govern over Drawings and Specifications except for specific modifications stated in the Supplementary Conditions, and except for Addenda.
.3 In case of conflict between the Drawings and the Specifications, the Specifications shall govern unless the requirement(s) in the Drawings is/are more stringent and/or of higher quality and/or of higher quantity.
.4 In the case of conflict within the Drawings, the following shall govern:
    1) Schedules, when identified as such, shall govern over all other portions of the Drawings.
    2) Specific notes shall govern over other notes and all other portions of the Drawings, except schedules described in the preceding Clause.
    3) Larger scale Drawings shall govern over smaller scale Drawings.
    4) Detail Drawings shall govern over standard plates bound within the Project Manual.
    5) Figured or numerical dimensions shall govern over dimensions obtained by scaling.

1.5.2 Omissions: If the Contract Documents are not complete as to any minor detail or required construction system or with regard to the manner of combining or installing of parts, materials, or equipment, but there exists accepted trade standard for good and workmanlike construction, such detail shall be deemed to have been implied by the requirements of the Contract Documents in accordance with such standard.

.1 "Minor Detail" shall include the concept of substantially identical components, where price of each such component is small even though aggregate cost or importance is substantial, and shall include a single component which is incidental, even though its cost or importance may be substantial. Quality and quantity of parts or material so supplied shall conform to trade standards and be compatible with type, composition, strength, size and profile of parts or materials otherwise set forth in the Contract Documents.

1.6 REQUESTS FOR INFORMATION, CLARIFICATION OR ADDITIONAL INSTRUCTIONS

1.6.1 Requests for Information (RFI): Should the Contractor discover conflicts, omissions, or errors in the Contract Documents, or have any questions concerning interpretation or clarification of Contract Documents, the Contractor shall immediately submit to the State in writing an RFI that complies with the following requirements:

.1 All RFIs, whether by the Contractor, a Subcontractor or supplier at any tier, shall be submitted by the Contractor to the State.
.2 RFIs shall be numbered sequentially and be presented in the format provided by the State.
.3 The Contractor shall clearly and concisely set forth the single issue for which interpretation or clarification is sought, indicate Specification Section number, article and subarticle numbers, and Contract Drawing number, and detail, or other item involved, and state why a response is required from the State.
.4 The Contractor shall set forth its own interpretation or understanding of the requirements, along with reasons why it has reached such an understanding in each RFI.
.5 RFIs shall be submitted in a timely manner in order that they may be adequately researched and answered before the response affects any critical activity of the Work.
.6 The State will review all RFIs to determine whether they are truly RFIs within the meaning of the term as defined in Paragraphs 1.1.33 and 1.6.1. RFI's which are determined to be not within the meaning of the term and/or RFIs where answers can readily be found in the Drawings and Project Manuals shall be deemed to be superfluous and the cost for reviewing these RFIs will be back-charged to the Contractor.
.7 Responses to RFIs will be made within 14 days unless the State notifies the Contractor in writing that a response will take longer. The 14 days will begin when the RFI is received and dated by the State. Should the State respond sooner, the Contractor shall not assume that a new timeline has been established. Delays in the progress of the Work due to late submittal of RFIs by the Contractor are solely the responsibility of the Contractor.
.8 Responses from the State will not change any requirement of the Contract unless so noted by the State in the response to the RFI.
.9 Should the Contractor believe that a response to an RFI causes a change to the requirements of the Contract, the Contractor shall, before proceeding, give written notice to the State, indicating that the Contractor considers the State's response to the RFI to be a Change Order. An RFI will not be considered to be automatically a notice for a Change Order. The Contractor shall give separate written notice within 7 days of receipt of the State's response to the RFI. If the Contractor fails to give notice within 7 days or prior to commencement of the change, the Contractor shall forfeit the right to seek additional time or cost under Article 6.

1.6.2 Additional Detailed Instructions: The State may furnish additional detailed written and/or graphic instructions to further explain the work, and such instructions shall be a part of the Contract requirements. Should additional detailed instructions, in the opinion of the Contractor, constitute work in excess of the scope of the Work, the Contractor shall submit written notice to the State within 14 days following receipt of such instructions, and in any event prior to commencement of the work thereon. The State will then consider the notice; and, if in the State's judgment it is justified, the State's instructions will be revised or the extra work authorized in accordance with the provisions of Article 6.

ARTICLE 2 - ADMINISTRATION OF THE CONTRACT

2.1 INFORMATION AND/OR SERVICES REQUIRED OF THE STATE

2.1.1 Information and/or services under the State's control shall be furnished by the State within a mutually agreed upon response time so as to avoid delay in the orderly progress of the Work.

2.1.2 The Contractor will be furnished Drawings and Project Manuals as specified in the Contract Documents.

2.2 ADMINISTRATION OF THE CONTRACT

2.2.1 The State will provide administration of the Contract as described in the Contract Documents during construction, until final payment is due and during the correction period described in Paragraph 12.2 and throughout the guarantee period.

2.2.2 The State will visit the Project site appropriate to the stage of construction to become familiar with the progress and quality of the completed work and to determine if the Work is in accordance with the Contract Documents.

2.2.3 Unless so specified in the Contract Documents, the State will not have control over construction means, methods, techniques, sequences or procedures, or safety precautions and programs in connection with the Work. The State will not be responsible for the Contractor's failure to carry out the Work in accordance with the requirements of the Contract Documents. The State will not be responsible for acts, errors, or omissions of the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or of any other persons performing portions of the Work.

2.2.4 Communications Facilitating Contract Administration: Communications by and with the State's consultants shall be through the State. Communications by and with Subcontractors**,** Sub-subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the State.

2.2.5 If the State observes work that appears to not comply with the requirements of the Contract Documents, the State will have the authority to reject the Work. Whenever the State considers it necessary or advisable for implementation of the intent of the Contract Documents, the State will require additional inspection or testing of the Work, in accordance with Subparagraphs 3.13.2 and 3.13.3, whether or not such work is fabricated, installed or completed.

2.2.6 The State will review and take action upon the Contractor's submitted Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Review of submittals is not conducted for the purpose of determining the accuracy and completeness of other details, such as dimensions and quantities, nor for substantiating instructions for installation or performance of equipment or systems, which remain the responsibility of the Contractor.

2.2.7 Substitutions and Approved Equals: Alternative material(s), article(s), or equipment that are of equal quality and of required characteristics for the purpose intended may be proposed by the Contractor. The State will examine proposed alternatives for compliance with the Contract Documents. The proposed material(s), article(s), or equipment, will be reviewed for comparative quality, suitability, and performance against the product(s) specified in the Contract Documents. Refer to Subparagraph 3.12.10, for Substitution procedures. If Contractor’s substitution is accepted, the Contractor shall be responsible for the costs of any changes resulting from the substitution, including, but not limited to redesign costs of the Project.

2.2.8 The State will conduct inspections to determine the Contractor’s compliance with the Contract Documents and the date of Completion; will receive, for review and record, written warranties and related documents required by the Contract Documents and assembled by the Contractor; and will issue a final Payment Authorization upon compliance with the requirements of the Contract Documents and Acceptance of the Work.

2.3 BREACHES, DEFAULTS AND TERMINATION FOR CAUSE

2.3.1 If the Director deems that the Contractor has failed to supply an adequate working force, or material of proper quality, or has failed to comply with Public Contract Code Section 10262, or has failed in any other respect to prosecute the Work with the diligence and force specified by the Contract, the Director may:

.1 after written notice of at least 5 days to the Contractor, specifying the defaults to be remedied, provide any such labor or materials and deduct the cost from any money due or to become due to the Contractor under the Contract; or
.2 if the Director considers that the failure is sufficient ground for such action, the Director may give written notice of at least 5 days to the Contractor and the Contractor's sureties, that if the defaults are not remedied, the Contractor's control over the Work will be terminated.

2.3.2 Should the State exercise its rights to terminate as noted in Subparagraph 2.3.1, the State may, without prejudice to any other rights or remedies of the State and subject to any prior rights of the Surety:

.1 terminate employment of the Contractor;
.2 take possession of the Project site, materials, equipment, tools, appliances, and construction equipment and machinery owned by the Contractor;
.3 accept assignment of Subcontractor Agreements pursuant to Paragraph 4.4; and/or
.4 finish the Work by whatever method(s) the State may deem expeditious and appropriate.

2.3.3 When the State terminates the Contract for reasons provided in Subparagraph 2.3.1, the Contractor shall not be entitled to receive any further payment until Completion of the Work. If the costs incurred by the State because of termination under Subparagraph 2.3.1 exceed the unpaid balance, the Contractor shall pay the difference to the State.

2.4 TERMINATION FOR THE STATE'S CONVENIENCE

2.4.1 The State reserves the right to terminate this Contract or any part thereof, due to an Act of God or for its sole convenience. In the event of such termination, the Contractor shall immediately stop hereunder and shall immediately cause its Subcontractors, Sub-subcontractors and material suppliers at any tier, to immediately stop work, leaving the site in a safe and secured condition. The Contractor shall not be paid for any work performed or costs incurred after the termination date that could have been avoided.

2.4.2 The Contractor shall be paid in accordance with the provisions of Article 8; except that the amount due the Contractor shall be based upon the State's final estimate of the Work completed, or acceptable materials furnished but not used, to the date of suspension of the Work, less any amounts required to be withheld pursuant to Article 8, and less any prior payment(s) made to, or on the account of the Contractor.

2.5 SUSPENSION BY THE STATE FOR CONVENIENCE

2.5.1 The State may, by written notice, order the Contractor to suspend, delay or interrupt the Work, in whole or in part, for such period of time as the State may determine.

2.5.2 An adjustment may be claimed by the Contractor in accordance with Article 6 and Article 7 for changes in the Work, caused by a suspension, delay or interruption. No adjustment will be made to the extent:

.1 that Contractor’s performance of the Work, is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
.2 that an equitable adjustment is made or denied under another provision of the Contract.

ARTICLE 3 - CONTRACTOR

3.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY THE CONTRACTOR

3.1.1 The Contractor shall carefully study and compare the Contract Documents with each other and shall report to the State, in writing, any errors, inconsistencies or omissions discovered. If the Contractor performs any work knowing it involves a recognized error, inconsistency or omission in the Contract Documents, without such notice to the State the Contractor shall assume responsibility for such performance and shall bear the cost for correction.

3.1.2 The Contractor shall take field measurements and verify field conditions and shall compare such field measurements, conditions and other related information known to the Contractor with the Contract Documents before proceeding.

3.1.3 The Contractor shall promptly, and before such conditions are disturbed, notify the State in writing of:

.1 subsurface or latent physical conditions at the site differing materially from those indicated, or
.2 unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract.
.3 Hazardous materials.

3.1.4 The State will promptly investigate the conditions, and if the State finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the Work, whether or not changed as a result of such conditions, a Change Order will be issued in accordance with Article 6.

3.2 SUPERVISION AND CONSTRUCTION PROCEDURES

3.2.1 The Contractor shall supervise and direct the Work. The Contractor shall be responsible for, and have control over, construction means, methods, techniques, sequences, procedures, safety precautions and programs in connection with the Work, and for coordinating the Work under the Contract; unless otherwise noted or specified in the Contract Documents.

3.2.2 The Contractor shall be responsible to the State for acts and omissions of the Contractor's employees, Subcontractors, Sub-subcontractors or material suppliers and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor.

.1 Subcontractor Responsibility: The Contractor shall be responsible for the actions or inaction of Subcontractors, Sub-subcontractors or material suppliers, at all tiers, regardless of whether they are a Disabled Veterans Business Enterprise (DVBE) firm or are stipulated suppliers or sole sourced. No claim, request for equitable adjustment or Change Order request shall be submitted to the State for any action of any Subcontractor, Sub-subcontractor or material supplier, at any tier, unless the Contractor can demonstrate that the State is the proximate cause of the change or delay alleged in such request. The State will not accept any responsibility or liability for any action or inaction of any Subcontractor, Sub-subcontractor or material supplier, at any tier, except to the extent that the State is the proximate cause of the change or delay.

3.2.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents, either by activities or duties of the State, the State's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.2.4 The Contractor shall be responsible for inspections of portions of the Work already completed under the Contract to determine that such portions are in proper condition to receive subsequent work. If the Contractor determines that some work performed on the Project does not comply with the requirements of the Contract Documents, the Contractor shall repair or replace such defective work at the Contractor's sole expense.

3.2.5 Until Acceptance of the Work, the Contractor shall have the charge and care thereof, and shall bear risk of injury or damage to any part of the Work by action of the elements (except for an Act of God, or natural disaster as proclaimed by the State or Federal Government), or from any other reason except for such damages as are directly caused by acts of the Federal or State Government and the public enemy, except as provided in Paragraph 8.5.

3.3 LABOR AND MATERIALS

3.3.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. Materials, articles and equipment furnished by the Contractor for incorporation into the Work shall be new unless otherwise specified in the Contract Documents.

3.3.2 Hours of Labor: Workers are limited and restricted to 8 hours during any one calendar day, and 40 hours during any one calendar week except that pursuant to Labor Code Section 1815, any work performed in excess of 8 hours per day and 40 hours during any one week, shall be permitted upon compensation for hours worked in excess of 8 hours per day at not less than 1-1/2 times the basic rate of pay. The Contractor shall pay the State $25 as a penalty for each worker for each calendar day worked in violation of the above limitations and restrictions.

3.3.3 Prevailing Wage: The Contractor shall comply with Labor Code, Section 1774 and 1775. Pursuant to Section 1774, the Contractor and any subcontractors, regardless of tier, shall pay not less than the specified prevailing wage rates to all workers employed in the execution of the Contract. In accordance with Section 1775, the Contractor and any subcontractor under the Contractor shall forfeit to the State not more than $50 for each calendar day, or portion thereof, for each worker paid less than the prevailing wage rates for the work or craft, in which the worker is employed for any work executed under the Contract by the Contractor or by any subcontractor in violation of the provisions of the Labor Code; and, in particular, Labor Code, Sections 1770 to 1780, inclusive. In addition to such forfeiture, the difference between such stipulated prevailing wage rates and the amount paid to each worker for each day, or portion thereof, shall be paid to each underpaid worker by the Contractor or subcontractor. This provision shall not apply to properly registered apprentices.

.1 Pursuant to Labor Code, Section 1770, the Director of the Department of Industrial Relations has ascertained the general prevailing rate of per diem wages and a general prevailing rate for legal holiday and overtime work for each craft required for execution of the Contract. The Contractor shall obtain copies of the prevailing rate of per diem wages from the Department of Industrial Relations, Division of Labor Statistics & Research, PO Box 420603, San Francisco, CA 94142-0603, (415) 703-4780; or wage rates may be accessed on the internet at http://www.dir.ca.gov/DLSR/statistics_research.html.The Contractor is responsible to read, understand and comply with all the guidelines, including the fine print in the prevailing wage determinations; and shall post a copy of the prevailing wage rates, specific to the Project, at the Project site.

.2 Wage rates set forth are the minimum that may be paid by the Contractor. Nothing herein shall be construed as preventing the Contractor from paying more than the minimum rates set. No extra compensation will be allowed by the State due to the inability of the Contractor to hire labor at minimum rates, nor for necessity for payment by the Contractor of subsistence, travel time, overtime, or other added compensations, all of which possibilities are elements to be considered and ascertained to the Contractor's own satisfaction in preparing the Bid Form.

.3 If it becomes necessary to employ crafts other than those listed in the General Prevailing Wage Rate booklet, the Contractor shall contact the Division of Labor Statistics and Research as noted above. The rates thus determined shall be applicable as minimum for the contract and incorporated in the bid. When the wage determination shows an expiration date (noted by a double asterisk**), to expire during the term of the contract, the Contractor must call or write the DIR to obtain the new rates and incorporate them in the bid to be applicable for the term of the contract.

.4 The Contractor and each subcontractor, regardless of tier, shall keep an accurate payroll record showing the names, addresses, social security numbers, work classifications, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and/or subcontractor in connection with the Work. Payroll records shall be certified and shall be on forms provided by the Division of Labor Standards Enforcement, or shall contain the same information as those forms. The Contractor's and subcontractor's certified payroll records for each employee shall be submitted with each payment request, covering the period of the payment request.

3.3.4 Travel and Subsistence Payments: The Contractor shall pay travel and subsistence payments to persons required to execute the Work as such travel and subsistence payments are defined in applicable collective bargaining agreements filed with the Department of Industrial Relations, pursuant to Labor Code, Sections 1773.1 and 1773.9.

3.3.5 Apprentices: Properly registered apprentices may be employed in the execution of the Work. Every apprentice shall be paid the standard wage paid to apprentices under the regulations of the craft or trade at which the apprentice is employed, and shall be employed only at the work of the craft or trade to which the apprentice is registered. The Contractor and each Subcontractor shall comply with the requirements of Labor Code, Section 1777.5, and any related regulations regarding the employment of registered apprentices.

3.4 NONDISCRIMINATION CLAUSE

3.4.1 Definitions: As they pertain to the Standard California Nondiscrimination Construction Contract Specifications:

.1 Administrator: The Administrator, Office of Compliance Programs (OCP), California Department of Fair Employment and Housing (DFEH), or any person to whom the Administrator delegates authority.

.2 Minority includes:

1) Black (all persons having primary origins in any of the Black racial groups of Africa, but not of Hispanic origin); or
2) Hispanic (all persons of primary culture or origin in Mexico, Puerto Rico, Cuba, Central or South America, or other Spanish derived culture or origin regardless of race); or
3) Asian/Pacific Islander (all persons having primary origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent or the Pacific Islands); or
4) American Indian/Alaskan Native (all persons having primary origins in any of the original peoples of North America and who maintain culture identification through tribal affiliation or community recognition).

3.4.2 Whenever the Contractor or any Subcontractor subcontracts a portion of the Work, it shall physically include in each subcontract of $5,000 or more, the Nondiscrimination Clause in the Contract directly or through incorporation by reference. Any subcontract for work involving a construction trade shall also include the Standard California Construction Contract Specifications, either directly or through incorporation by reference.

3.4.3 The Contractor shall implement the specific nondiscrimination standards provided in Clauses 3.4.6.1 through 3.4.6.5.

3.4.4 Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities and/or women shall excuse the Contractor's obligations under these specifications, Government Code, Section 12990, or the regulations promulgated pursuant thereto.

3.4.5 In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees shall be employed by the Contractor during the training period, and the Contractor shall have made a commitment to employ the apprentices and trainees upon the completion of their training, subject to the availability of employment opportunities. Trainees shall be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.

3.4.6 The Contractor shall take specific actions to implement the Contractor's nondiscrimination program. The evaluation of the Contractor's compliance with these specifications shall be based upon the Contractor's effort to achieve maximum results from the Contractor's actions. The Contractor shall be able to demonstrate fully the Contractor's efforts under Steps .1 through .5 below:

.1 Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites and at all facilities at which the Contractor's employees are assigned to work. The Contractor, whenever possible, shall assign two or more women to each construction project. The Contractor shall specifically ensure that all leadpersons, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligations to maintain such a working environment, with specific attention to minority and/or female individuals working at such sites or in such facilities.

.2 Provide written notification within 7 days to the Director of DFEH when the union(s) with which the Contractor has a collective bargaining agreement(s) has not referred to the Contractor a minority person and/or woman sent by the Contractor, or when the Contractor has other information that the union(s) referral process has impeded the Contractor's efforts to meet the Contractor's obligations.

.3 Disseminate the Contractor's equal employment opportunity policy by providing notice of the policy to unions and training, recruitment and outreach programs and requesting their cooperation in assisting the Contractor to meet the Contractor's obligations; and by posting the company policy on bulletin boards accessible to all employees at each location where construction work is performed.

.4 Ensure all personnel making management and employment decisions regarding hiring, assignment, layoff, termination, conditions of work, training, rates of pay or other employment decisions, including all supervisory personnel, superintendents, general leadpersons, on-site leadpersons, etc., are aware of the Contractor's equal employment opportunity policy and obligations, and discharge their responsibilities accordingly.

.5 Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the equal employment opportunity policy and the Contractor's obligations under these specifications are being carried out.

3.4.7 Contractors are encouraged to participate in voluntary associations which assist in fulfilling their equal employment opportunity obligations. The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of the Contractor's obligations under these specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work-force participation, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. It is the Contractor's obligation to comply.

3.4.8 The Contractor is required to provide equal employment opportunity for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of the Fair Employment and Housing Act (Government Code, Section 12990 et seq.) if a particular group is employed in a substantially disparate manner.

3.4.9 Establishment and implementation of a bona fide affirmative action plan pursuant to Section 8104(b) of Title 2, California Code of Regulations (CCR), shall create a rebuttable presumption that the Contractor is in compliance with the requirements of Government Code, Section 12990, and its implementing regulations.

3.4.10 The Contractor shall not use the nondiscrimination standards to discriminate, harass or allow harassment against any person because of race, color, religion, sex, national origin, ancestry, physical disability (including HIV and AIDS), mental disability, medical condition (cancer), marital status, or age over 40, denial of family and denial of family care leave.

3.4.11 The Contractor shall not enter into any subcontract with any person or firm decertified from State contracts pursuant to Government Code, Section 12990.

3.4.12 The Contractor shall carry out such sanctions and penalties for violation of these specifications and the Nondiscrimination Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Government Code, Section 12990 and its implementing regulations by the awarding agency. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Government Code, Section 12990.

3.4.13 The Contractor shall designate a responsible official to monitor all employment-related activity to ensure that the company's equal employment opportunity policy is being carried out, to submit reports relating to the provisions herein as may be required by OCP, and to keep records. Records shall at least include for each employee the name, address, telephone number, construction trade, union affiliation, if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice

trainee, helper or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work is performed. Records shall be maintained in any easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, the Contractor shall not be required to maintain separate records.

3.5 GUARANTEE

3.5.1 The Contractor unconditionally guarantees the Work will be completed in accordance with the requirements of the Contract Documents, and will remain free of defects in workmanship and materials for a period of 1 year from the date of Completion of the Work of the Project, unless a longer guarantee period is specifically called for in the Contract Documents. The Contractor shall repair or replace work, or adjacent work, or both, that may have been damaged or displaced, which was not in accordance with the requirements of the Contract Documents, or that may be defective in its workmanship or material within the guarantee period specified in the Contract Documents, without any expense whatsoever to the State; ordinary wear and tear and abuse excepted.

3.5.2 The Contractor further agrees, within 14 days after being notified in writing by the State, of work not in accordance with the requirements of the Contract Documents or defects in the Work, that the Contractor shall commence and execute, with due diligence, work necessary to fulfill the terms of the guarantee. If the State finds that the Contractor fails to perform the work under the guarantee, the State will proceed to have the work completed at the Contractor's expense and the Contractor will pay costs of the work upon demand. The State will be entitled to all costs, including attorney's fees necessarily incurred upon the Contractor's refusal to pay the above costs.

3.5.3 Notwithstanding the foregoing Subparagraph, in the event of an emergency constituting an immediate hazard to health or safety of State employees, property, or licensees, the State may undertake, at the Contractor's expense and without prior notice, work necessary to correct such hazardous condition(s) when it is caused by work of the Contractor not being in accordance with the requirements of the Contract Documents.

3.6 **TAXES:** The Contractor shall pay all applicable taxes for the Work, or portions thereof provided by the Contractor, which were legally enacted as of the bid date, whether or not yet effective or merely scheduled to go into effect.

3.7 PERMITS, FEES AND NOTICES

3.7.1 The Contractor shall secure and pay for required permits, governmental fees, licenses and inspections necessary to complete the Work, unless otherwise provided in the Contract Documents.

3.7.2 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities bearing on the performance of the Work.

3.7.3 If the Contractor observes that portions of the Contract Documents are at variance with applicable laws, statutes, ordinances, building codes, and rules and regulations, the Contractor shall promptly notify the State in writing. If the Contractor performs work known to be contrary, or should have known to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without prior notice to the State, the Contractor shall assume full responsibility for the Work and shall bear the attributable costs.

3.7.4 The Contractor is not subject to municipal, county, or district laws, rules, or regulations pertaining to building permits or regulating the design or construction of buildings upon State property, except as specified in the Contract Documents.

3.7.5 The Contractor may be subject to federal, state, municipal, county, local or district laws, rules, or regulations pertaining to off-site work, such as utility connections, fire protection systems and encroachment upon federal, state, private, city or county property, including, but not limited to storm water pollution prevention plans.

3.7.6 All construction work shall comply with the California Code of Regulations, Title 24, California Building Standards Code (CBSC), and other Applicable Codes, current edition, as of the bid date or as specified in the Specifications.

3.8 **ALLOWANCES:** The Contractor shall include in the Contract Sum, Allowances in accordance with the requirements of the Specifications, Division 01.

3.9 SUPERINTENDENT

3.9.1 The Contractor shall employ a competent Superintendent and assistants who shall be in attendance at theProject site during performance of the Work. The Superintendent, or the Contractor’s duly appointed representative, shall be the person in charge of

the construction of the Work and shall represent the Contractor. Communications given to the Superintendent shall be as binding as if given directly to the Contractor. All communications shall be confirmed in writing by the Contractor. Should the State deem the Superintendent to be incompetent, the State has the authority to request the Contractor to replace this person.

3.9.2 Should the Contractor decide to replace the Superintendent, the Contractor shall notify the State in writing, no fewer than 14 calendar days prior to the replacement. The Contractor shall submit the name and resume of the new Superintendent with the letter.

3.9.3 At any other time when the Superintendent is absent from the Project site because no Work is being performed, the Superintendent shall nevertheless keep the State advised of the Superintendent's whereabouts so that the Superintendent may readily be reached and available for consultation at the Project site at any time.

3.10 CONTRACTOR'S PROGRESS SCHEDULE

3.10.1 Within the time frame specified in the specifications and prior to the first payment request, the Contractor shall submit to the State a Progress Schedule, including submittal schedules, prepared in accordance with the Specifications, Division 01. The Progress Schedule shall show the order in which the Contractor proposes to execute the Work, dates on which the Contractor will start each major subdivision of the Work, and projected dates of completion of each such subdivision in accordance with the requirements of the Contract Documents. The Contractor shall submit adjusted Progress Schedules, including submittal schedules, to reflect changed conditions in accordance with the requirements of the Contract Documents with each payment request.

3.10.2 The Contractor shall, unless otherwise specified in the Contract Documents, or directed by the State in writing, show in the schedule that physical construction of the Work will start within 10 calendar days of the start date stipulated in the Notice to Proceed, and show execution to Completion, in accordance with the specified schedule, subject to adjustment in accordance with the requirements of the Contract Documents.

3.10.3 The Contractor shall provide an adequate work force, materials of proper quality, and equipment to properly execute the Work and to ensure completion of each part in accordance with the Progress Schedule and within the Contract Time specified.

3.10.4 The Contractor shall submit to the State a Schedule of Values consistent with the Progress Schedule and Article 8. The Schedule of Values will be used as a basis for payment in accordance with Article 8.

3.10.5 The State's review and acceptance of the Progress Schedule is for compliance with the requirements of the Contract Documents only. Review and acceptance by the State of the Progress Schedule does not mean approval and does not relieve the Contractor of any of the Contractor's responsibility for the accuracy or feasibility of the Progress Schedule, or of the Contractor's ability to meet the interim Project milestone dates and the date of Completion. The State's review and acceptance does not expressly or impliedly warrant, acknowledge or admit the reasonableness of the logic, durations, manpower or equipment loading of the Progress Schedule.

3.11 DOCUMENTS AND SAMPLES AT THE PROJECT SITE

3.11.1 The Contractor shall maintain at the Project site one record copy of the Drawings, Project Manual, Addenda, Change Orders and other modifications, in good order and marked currently to record changes and selections made during construction; and in addition, Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the State and shall be delivered to the State upon completion of the Work.

3.11.2 Daily Records Clause: The Contractor shall prepare and maintain daily inspection records to document the progress of the Work on a daily basis. Daily Records shall include a daily accounting of labor and equipment on the site for the Contractor and Subcontractors, at any tier. Daily Records shall make a clear distinction between work being performed under Change Order, base scope work, and/or disputed work. Daily Records shall be copied and provided to the State at the end of every week, unless otherwise agreed to in writing.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES (SUBMITTALS)

3.12.1 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate those portions of the work for which submittals are required and the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the State is subject to the limitations of Subparagraph 2.2.6.

3.12.2 The Contractor shall review, approve and submit to the State Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents within the number of days set forth in the Specifications, Division 01; except finishes which shall be submitted in a sequence so as to cause no delay in the progress of the Work or in the activities of the State or separate

contractors. Submittals that are not required by the Contract Documents may be returned to the Contractor without action.

3.12.3 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by the State. Such work shall be in accordance with reviewed submittals.

3.12.4 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and related field construction criteria, and has checked and coordinated the information contained within the submittal(s) with the requirements of the Contract Documents.

3.12.5 The Contractor shall not be relieved of the responsibility for any deviation from the requirements of the Contract Documents by the State's review of submittals unless the Contractor has specifically informed the State, in writing, or as directed by the State, of such deviation at the time of submittal, and the State has given written consent to the specific deviation. The State's review shall not relieve the Contractor of responsibility for errors or omissions in submittals. Any resulting cost increase due to such a deviation shall be the sole responsibility of the Contractor.

3.12.6 The Contractor shall respond per requirements of the Contract Documents, in writing or on resubmitted submittals, to revisions other than those requested by the State on previous submittals. After the second resubmittal of a specific item, that is still not accepted, the Contractor will be charged all costs of submittal review. The charges will be deducted from the Contract Sum.

3.12.7 Informational submittals on which the State is not expected to take action, may be identified in the Contract Documents.

3.12.8 When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the State will be entitled to rely upon the accuracy and completeness of such calculations and certifications.

3.12.9 When descriptive catalog designations, including manufacturer's name, product brand name, or model number(s) are referred to in the Contract Documents, such designations shall be considered as being those found in industry publications of current issue at date of first Invitation to Bid.

3.12.10 Substitutions and Approved Equals: Alternative material(s), article(s), or equipment that are of equal quality and of required characteristics for the purpose intended may be proposed by the Contractor for use in the Work, provided the Contractor complies with the Specifications, Division 01, and the following requirements:

.1 The Contractor shall submit a proposal for the alternative material(s), article(s), or equipment, in writing, within 35 days after Contract start date stated in the Notice to Proceed. In exceptional cases where the best interests of the State so require, the State may give written consent to a submittal or resubmittal received after expiration of the time limit designated.

.2 The proposal will not be considered unless the submittal is accompanied by complete information and descriptive data necessary to determine equality of offered material(s), article(s), or equipment. Samples shall be provided when requested by the State. Burden of proof as to comparative quality, suitability, and performance of offered material(s), article(s), or equipment shall be upon the Contractor. The State will be the sole judge as to such matters. In the event the State rejects the use of such alternative(s) submitted, then one of the particular products originally specified in the Contract Documents shall be furnished.

.3 If mechanical, electrical, structural, or other changes are required for installation, fit of alternative materials, articles, or equipment, or because of deviations from Contract Drawings and Specifications, such changes shall not be made without consent of the State, and shall be made without additional cost to the State.

3.13 TESTS AND INSPECTIONS

3.13.1 The Contractor shall at all times permit the State, its agents, officers, and employees to visit the Project site and inspect the Work, including shops where work is in preparation. This obligation shall include maintaining proper facilities and safe access for such inspection. Including, but not limited to providing lifts, ladders, scaffolds, platforms and paths of travel. When the Contract Documents require a portion of the Work to be tested, such portion of work shall not be covered up until inspected and approved by the State. The Contractor shall be solely responsible for notifying the State where and when the work is ready for inspection and testing. Should any work be covered without the required testing and approval, such work shall be uncovered and recovered at the Contractor's expense. Whenever the Contractor intends to perform work on Saturday, Sunday, or a legal holiday, the Contractor shall give written notice to the State of such intention at least 48 hours prior to performing the Work, so that the State may make necessary arrangements.

3.13.2 If the State determines that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, the State will instruct the Contractor, in writing, to make arrangements for additional testing, inspection or

approval by an entity acceptable to the State, and the Contractor shall give 48 hours written notice to the State of where and when tests and inspections will be conducted so that the State may observe the procedures. The State will bear the costs except as provided in Subparagraph 3.13.3.

3.13.3 If procedures for testing, inspection or approval under Subparagraphs 3.13.1 and 3.13.2 reveal failure of a portion(s) of the Work to comply with the Contract Documents, the Contractor shall bear all costs made necessary by such failure(s) including those of repeated procedures and compensation for the State's services and expenses.

3.13.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and delivered to the State within 14 days after each test.

3.14 **USE OF PROJECT SITE**

3.14.1 The Contractor shall confine operations at the Project site to areas permitted by law, ordinances, permits and the Contract Documents.

3.14.2 The Contractor shall perform no operations of any nature on or beyond the limits of Work or premises, except as such operations are authorized in the Contract Documents, or authorized by the State.

3.14.3 The Contractor shall ensure the limits of Work to be free of graffiti or other similar defacements during the time of the Contract; if such defacement occurs, then the Contractor shall properly remove, repair, or correct the affected area(s), or as otherwise directed by the State. The Contractor shall protect exposed surfaces within the limits of Work, with anti-graffiti coatings, and maintain such protection continuously effective during the time of the Contract.

3.14.4 Prohibitions: Pursuant to Subparagraph 3.2.2., the use of alcohol and tobacco products, and the use or possession of weapons, or illegal controlled substances by the Contractor, or others under the Contractor's control, on State property is not allowed. Residing on site in temporary facilities by the Contractor, or others under the Contractor's control, is not allowed unless otherwise specified in the Specifications, Division 01.

3.15 **CUTTING AND PATCHING**

3.15.1 The Contractor shall be responsible for cutting, fitting or patching as required to complete the Work.

3.15.2 The Contractor shall not damage nor endanger the Work by cutting, patching or otherwise altering the construction, and shall not cut nor otherwise alter the construction without prior written consent of the State.

3.16 **CLEANING UP**

3.16.1 The Contractor shall keep the Project site and surrounding areas free from waste materials and/or rubbish caused by operations under the Contract and at other times when directed by the State. At all times while finish work is being accomplished, floors shall be kept clean, free of dust, construction debris and trash. Upon completion of the Work, the Contractor shall remove from the Project site the Contractor's tools, construction equipment, machinery, and any waste materials not previously disposed of, leaving the Project site thoroughly clean, and ready for the State's final inspection.

3.16.2 If the Contractor fails to clean up as provided in the Contract Documents, the State may do so and charge the cost thereof to the Contractor.

3.17 **ACCESS TO WORK:** The Contractor shall provide the State continuous and safe access to the Work. Including, but not limited to providing lifts, ladders, scaffolds, platforms and paths of travel.

3.18 **ROYALTIES AND PATENTS:** The Contractor shall pay royalties and license fees. The Contractor shall defend suits or claims for infringement of patent rights and hold the State harmless.

3.19 **INDEMNIFICATION**

3.19.1 Duty To Defend: To the fullest extent permitted by law, the Contractor shall defend the State and any officer or employee of the State from and against suits filed against the State alleging claims, (including costs of attorneys fees) by reason of liability imposed by law and claims, including but not limited to, claims of personal injury, death, damage to property and loss of use thereof, or any claims arising out of the Contractor's performance of the Contract, or damages of other relief based on allegations of the failure of the Contractor, or the Contractor's Subcontractors to properly perform their obligations under the Contract, of the Contractor's violations of any legal duties, even if the allegations of any suit are groundless, false or fraudulent, and the Contractor

may make such investigation and settlement of any suit as the Contractor deems expedient. This duty to defend is separate and independent from the Contractor's duty to indemnify and hold harmless the State from such claims. Any failure to fulfill this obligation shall be a default of the Contractor's performance obligations under the Contract.

3.19.2 Duty to Indemnify: To the fullest extent permitted by the law, the Contractor shall hold harmless and indemnify the State and any officer or employee of the State from and against claims, losses and expenses (including costs of attorneys fees) by reason of liability imposed by law for claims, including but not limited to, claims of personal injury, death, damage to property and loss of use thereof, or any claims arising out of the Contractor's performance of the Contract, or damages or other relief based on allegations of the failure of the Contractor, or the Contractor's Subcontractors to properly perform their obligations under the Contract, or the Contractor's violations of any legal duties. Any failure to fulfill this obligation shall be a default of the Contractor's performance obligations under the Contract.

3.20 **AIR POLLUTION:** The Contractor and Subcontractors shall comply with State and/or local air pollution control rules, regulations, ordinances, and statutes that apply to work performed under the Contract. If there is a conflict between the State and local air pollution control rules, regulations, ordinances and statutes, the most stringent shall govern.

3.21 **CERTIFICATION BY CONTRACTOR OF RECYCLED CONTENT:** The Contractor shall certify in writing, under penalty of perjury, to the State, the minimum, if not exact, percentage of recycled content, both postconsumer material and secondary material, as defined in Public Contract Code Sections 12153 and 12200 and 12209, in materials, goods, or supplies offered or products used in the performance of the Contract, regardless of whether the product meets the required recycled percentage as defined in Sections 12153 and 12200 and 12209. The Contractor may certify that the product contains zero recycled content.

3.22 **UNFAIR BUSINESS PRACTICES:** The Contractor agrees and will require the Subcontractors and suppliers to agree to assign to the State all rights, title, and interest in and to all causes of action they may have under Section 4 of the Clayton Act (15 U.S.C. Section 15), or under the Cartwright Act (commencing with Section 16700 of the Business and Professions Code), arising from the purchase of goods, services or materials, pursuant to the Contract Documents or subcontract thereunder. An assignment made by the Contractor, and additional assignments made by Subcontractors and suppliers, shall be deemed to have been made and will become effective at the time the State tenders final payment to the Contractor, without further acknowledgment of the parties.

3.23 **CHILD SUPPORT COMPLIANCE ACT:** For any contract in excess of $100,000, the Contractor acknowledges in accordance with Public Contract Code Section 7110, that: (a) the Contractor recognizes the importance of child and family support obligations and shall fully comply with all applicable state and federal laws relating to child and family support enforcement, including, but not limited to, disclosure of information and compliance with earnings assignment orders, as provided in Chapter 8 (commencing with Section 5200) of Part 5 of Division 9 of the Family Code; and (b) the Contractor, to the best of its knowledge is fully complying with the earnings assignment orders of all employees and is providing the names of all new employees to the New Hire Registry maintained by the California Employment Development Department.

3.24 **NOT USED**

3.25 **CONTRACTOR REQUIRED NOTIFICATION OF CHANGES:** The Contractor shall notify the State's Representative in writing of any change to Contractor's name, status, or information including but not limited to:

1. Name
    a. An amendment is required to change the Contractor's name as listed on this Agreement. Upon receipt of Contractor's notification and legal documentation of the name change, the State will process the amendment. Payment of invoices presented with a new name cannot be paid prior to approval of said amendment.
    b. The State shall not be liable for penalties or interest on payments which are delayed due to Contractor's change of name and subsequent amendment processing.
2. Address/Location
3. Federal Employer Identification Number (FEIN)
4. Type of Organization or Legal Status – including:
    a. Corporate
    b. Partnership
    c. Individual/Sole-Ownership
    d. Joint Venture
    e. Limited Liability Company
    f. DBA
5. Ownership
6. Officers or Key Personnel
7. License
8. Other (Bankruptcy, Etc.)

Contractor shall immediately provide an updated Standard Form 204 (IRS/FTB form) to the Contracts Management & Procurement Services Section within five (5) calendar days of any such relevant change.

The State shall not be liable for penalties or interest on payments which are delayed do to Contractor's lack of proper or timely notice and documentation of a relevant change in status which impacts the State's ability to pay.

Contractor shall submit the firm's status change in writing including the Contract Number, Project Title and all necessary backup and legal documentation to support the status change to:

The State Department of General Services
Real Estate Services Division
Contracts Management & Procurement Services Section
707 Third Street, Suite 2-350
West Sacramento, CA 95605

ARTICLE 4 - SUBCONTRACTORS

4.1 SUBLETTING AND SUBCONTRACTING

4.1.1 The Contractor shall adhere to the rules governing subcontracting as set forth in the Subletting and Subcontracting Fair Practices Act, commencing with Public Contract Code, Section 4100. Subcontractor substitutions shall be in accordance with provisions of the Subletting and Subcontracting Fair Practices Act, beginning with Public Contract Code, Section 4100. Violations of this Act by the Contractor may subject the Contractor to penalties and disciplinary action as provided by the Subletting and Subcontracting Fair Practices Act.

4.1.2 The Contractor shall be responsible for the Work. Persons engaged in the Work of the Project are the responsibility and under the control of the Contractor. The Contractor shall give personal attention to fulfillment of the Contract and shall keep the Work under the Contractor's control. When any Subcontractor fails to execute a portion of the Work in a manner satisfactory to the State, the Contractor shall remove such Subcontractor immediately upon written request notice from the State, and the Subcontractor shall not again be employed on the Project. Although Specification Sections of the Contract Documents may be arranged according to various trades or general grouping of work, the Contractor is not obligated to sublet work in any manner. The State will not entertain requests to arbitrate disputes among Subcontractors or between the Contractor and Subcontractor(s) concerning responsibility for performing any part of the Work.

4.1.3 The State may not permit a contractor or subcontractor who is ineligible to bid or work on, or be awarded, a public works project pursuant to Sections 1777.1 or 1777.7 of the Labor Code to bid on, be awarded, or perform work as a subcontractor on a public works project.

.1 Any contract on a public works project entered into between a contractor and a debarred subcontractor is void as a matter of law. A debarred subcontractor may not receive any public money for performing work as a subcontractor on a public works contract, and any public money that may have been paid to a debarred subcontractor by a contractor on the project shall be returned to the awarding body. The Contractor shall be responsible for the payment of wages to workers of a debarred subcontractor who has been allowed to work on the Project.

4.2 SUBCONTRACTUAL RELATIONS

4.2.1 The Contractor shall make available to each proposed Subcontractor, prior to the execution of a Subcontractor Agreement, copies of the Contract Documents to which the Subcontractor will be bound. Upon written request of the Subcontractor, the Contractor shall identify to the Subcontractor the terms and conditions of the proposed Subcontractor Agreement which may or may not be at variance with the Contract. Subcontractors shall similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors. The Contractor shall, by Subcontractor Agreement, require each Subcontractor, to the extent of the work to be performed by the Subcontractor:

.1 To be bound to the Contractor by terms of the Contract.
.2 To assume toward the Contractor the obligations and responsibilities which the Contractor, by the Contract, assumes toward the State.
.3 To preserve and protect the rights of the State under the Contract Documents with respect to the work to be performed by the Subcontractor.
.4 To be allowed, unless specifically provided otherwise in the Subcontractor Agreement, the benefits of rights, remedies and redress against the Contractor that the Contractor, by the Contract, has against the State.
.5 To enter into similar agreements with Sub-subcontractors.

4.2.2 Subcontractor Payments: The Contractor shall pay the Contractor's Subcontractors for work performed no later than 10 days after receipt of each progress payment. If there is a good faith dispute over all or any portion of the amount due a Subcontractor on a progress payment, the Contractor may withhold no more than 150 percent of the disputed amount. This provision shall apply to Sub-subcontractors also. A violation of these requirements invokes the payment and penalty provisions of Public Contract Code, Section 10262 and Section 10262.5.

4.3 **DISABLED VETERAN BUSINESS ENTERPRISE PROGRAM:** Pursuant to Public Contract Code (PCC) Section 10115 et. seq., the Contractor shall use, employ and utilize Disabled Veteran Business Enterprise (DVBE) subcontractors, sub-subcontractors or material suppliers who were listed in their bid documents for DVBE Program participation, to the full extent of the amount of money and/or percentage of commitment manifested in the bid documents. If the Contractor wishes to substitute any listed DVBE subcontractors, sub-subcontractors or material suppliers for just and legal cause, the Contractor shall follow the dictates of PCC Sections 4107 and 10115.12b, as well as Military and Veterans Code (M&VC) Section 999.5(e) and California Code of Regulations, Title 2, Section 1896.64. The DVBE may only be replaced by another DVBE and shall obtain the written authorization of the State prior to any such substitutions. The Contractor shall not unilaterally substitute a listed DVBE subcontractor, sub-subcontractor or material supplier. Failure of Contractor to seek substitution and adhere to the DVBE participation requirement identified in the bid may be cause for contract termination, recovery of damages under rights and remedies due to the State, and penalties as outlined in M&VC Section 999.9; PCC Sections 4110 and PCC Section 10115.10.

4.4 **CONTRACT ASSIGNMENTS:** Performance of the Contract may not be assigned except upon written consent of the State. Consent will not be given to an assignment which would relieve the Contractor or the Contractor's Surety of their responsibilities under the Contract.

ARTICLE 5 - CONSTRUCTION BY THE STATE OR BY SEPARATE CONTRACTORS

5.1 STATE'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

5.1.1 The State reserves the right to perform work or operations related to the Project with the State's own work force, and to award separate contracts in connection with other portions of the Project, and other construction or operations on the Project site or adjacent to the Project. The Contractor shall at all times conduct the Work so as to impose no hardship on the State or others engaged in work on the Project, nor to cause any unreasonable delay or hindrance to the Project.

5.1.2 When separate contracts are awarded for different portions of the Project, "the Contractor" in the Contract Documents in each case shall mean the contractor who executes each separate contract. Each contractor is the intended third part beneficiary of other contracts for the Project.

5.1.3 The Contractor shall not cause unnecessary hindrance or delay to another contractor working on or near the Project. If the performance of any contract for the Project is likely to be interfered with by the simultaneous execution of some other separate contract or contracts, the State will decide which contractor may proceed.

5.1.4 Costs caused by defective or ill-timed work shall be borne solely by the responsible contractor.

5.2 MUTUAL RESPONSIBILITY

5.2.1 The Contractor shall cooperate fully with the State and separate contractors with regard to the execution of their work as follows:

.1 The Contractor shall cooperate fully with the State and all separate contractors with regard to introduction and storage of their materials and equipment.

.2 The Contractor shall coordinate with the State and separate contractors with regard to construction scheduling and sequence of operations, subject to approval of the State.

.3 Each contractor shall monitor the schedule and progress of each other contractor whose work affects its work, and shall provide timely notice to the State of potential problems of interface so that the State can mitigate the problem.

.4 The Contractor shall properly connect the Work to the work of the State or the separate contractors.

.5 The Contractor shall inspect the work of the State or other contractors affecting the Work and promptly report to the State in writing irregularities or defects in the separate work, which renders it unsuitable for reception or connection of the Work.

.6 Failure of the Contractor to inspect and report shall constitute acceptance of the other work as fit and proper to receive the Work, except as to defects which may develop in the other work after execution of the Contractor’s Work.

5.2.2 Claims Between Separate Contractors:

.1 Should the Contractor cause damage to the work or property of any separate contractor on the Project, the Contractor shall, upon due notice, settle with such other contractor by agreement, mediation or arbitration, if they will so settle.

.2 If such separate contractor sues the State or initiates an arbitration proceeding on account of any damage alleged to have been so sustained, the State will notify the Contractor who shall defend such proceedings at the Contractor's sole expense.

.3 The Contractor shall pay or satisfy any judgement or award against the State, arising therefrom. In addition, the Contractor shall pay the State for attorney's fees, court, arbitration or mediation costs and additional administrative, professional, consultant, inspection, testing and other service costs which the State has incurred.

5.2.3 The Contractor shall promptly remedy damage wrongfully caused by the Contractor to any completed or partially completed construction or to any property of the State or separate contractors as provided in Subparagraph 10.1.6.

5.2.4 Cutting and Patching Under Separate Contracts: The Contractor shall be responsible for any cutting, fitting and patching that may be required to complete the Work, except as otherwise specifically provided for in the Contract Documents. The Contractor shall not endanger any work of the State or of any other contractor by cutting, excavating, or otherwise altering any work, except with the written consent of the State.

5.3 **STATE'S RIGHT TO CLEAN UP:** If a dispute arises among the Contractor, separate contractors and/or the State as to the responsibility under their respective contracts for maintaining the Project site and surrounding areas free from waste materials and rubbish as described in Paragraph 3.16, the State may clean up and allocate the costs among those responsible.

ARTICLE 6 - CHANGES IN THE WORK

6.1 **GENERAL**

6.1.1 The State may order changes, including but not limited to, revisions to the Contract Documents, performance of extra work, and the elimination of work, without invalidating the Contract. Orders for such changes will be in writing. Changes shall not affect the obligations of the sureties on the contract bonds nor require their consent. Contract Time and Contract Sum will be adjusted, by written Change Order for changes which materially increase or decrease the time or cost or performance.

.1 Proposed Change Order: The Contractor will be issued a written proposed Change Order by the State describing the intended changes to the Work.

.2 Timeline: Within 14 days the Contractor shall submit to the State the Contractor's proposed cost estimate to be added or deducted from the Contract Sum due to the change, authenticated in full by completely detailed estimates and other authenticators of the cost by the Contractor, Subcontractors, Sub-subcontractors, vendors or material suppliers, and any adjustments of time of Completion of the entire Work that is directly attributable to the State's proposed Change Order.

.3 Agreement: If an agreement is reached as to the adjustment in compensation for performance of changed Work, but an agreement is not reached as to the adjustment of Time for such Work, then the Contractor shall proceed with the Work at the agreed cost, reserving to the Contractor the right to further pursue the Contractor's claim for adjustment of time in accordance with Paragraphs 7.4 and 9.1.

.4 Failure to Submit Cost Estimate: If the Contractor fails to submit the cost estimate within the 14 days timeline, or there is failure to agree to the Cost, then the State shall have the right to issue an order in writing to the Contractor to commence Work immediately, and the Contract Sum shall be changed in accordance with the State's estimate of cost, unless, within 14 days following completion of the added Work or with written notice to delete the Work, the Contractor submits to the State written proof that the State's estimate is in error.

6.1.2 The Contractor, when ordered by the State, shall proceed with changes before agreement is reached on adjustment, if any, in compensation or time for performance, and shall furnish to the State records as specified in Clause 6.2.1.3. If the Contractor fails to provide such records, the State's records will be used for the purpose of adjustment, if any, in Contract Time and Contract Sum.

.1 Contractor may make payment requests for such work.

6.1.3 The Contractor will forfeit compensation for cost and /or time for proceeding with changes to the Work without written authorization from the State. The Contractor shall notify the State, in writing, and request an evaluation whenever it appears a change is necessary. This written notice shall be made within 24 hours of such discovery. If the State concurs with the Contractor's request for a change to the Work, the State will follow the procedures under Article 6. Delays as a result of these requests will be the

responsibility of the Contractor.

6.2 **CHANGE ORDER**

6.2.1 Methods used in determining adjustments to the Contract Sum shall be based on one of the following methods:

.1 By mutual acceptance of a lump sum increase or decrease in costs. Upon the State's written request, the Contractor shall furnish a detailed estimate of increase or decrease in costs, together with cost breakdowns and other support data within the time specified in such request. The Contractor shall be responsible for any additional costs caused by the Contractor's failure to provide the estimate within the time specified.

.2 By the State, on the basis of the State's estimate of increase or decrease in the costs.

.3 By the State, whether or not negotiations are initiated as provided in Clause 6.2.1.1, by actual and necessary costs, as determined by the State, on the basis of records. Beginning with the first day and at the end of each day, the Contractor shall furnish to the State detailed hourly records for labor, construction equipment, and services; and itemized records of materials and equipment used that day in performance of the changes. Such records shall be on a form acceptable to the State. Such records shall be signed by the Contractor and, when agreed to by the State, will become the basis for compensation for the changed work. Such agreement shall not preclude subsequent adjustment based upon later audit by the State.

.4 By unit prices stated in the Contract Documents, or subsequently agreed upon.

.5 By a manner agreed upon by the State and the Contractor.

6.2.2 Allowable Costs: The only costs which will be allowed due to changes in the Work shall be computed in the following manner:

.1 Labor: Compensation for labor shall include the applicable payroll cost for labor, including first level supervision providing physical construction labor directly engaged in performance of the changes. Others, who may be involved in the preparation of the change order, including, but not limited to supervisors, superintendent, engineers, or estimators, shall be considered as overhead costs under Clause 6.2.2.4. Payroll cost for labor shall be the General Prevailing Wage Rates applicable for this project and in the locality for performance of the changes. In addition to the published rates, only social security, worker compensation, state and federal taxes shall be included in the total payroll cost. Other costs shall be considered as mark-ups under Clause 6.2.2.4. Use of a classification which would increase labor costs will not be permitted.

.2 Materials and Equipment: Compensation for materials and equipment shall include the necessary costs for materials and equipment directly required for performance of the changes. Cost of materials and equipment may include costs of transportation and delivery. If discounts by suppliers are available to the Contractor, they shall be credited to the State. If materials and equipment are obtained from a supply or source owned by, or in part, by the Contractor, payment therefore will not exceed current wholesale prices for such materials and equipment. If, in the opinion of the State, the cost of materials and equipment is excessive, or if the Contractor fails to furnish satisfactory evidence of costs from supplier, the cost of materials and equipment shall be the lowest current wholesale price at which similar materials and equipment are available in quantities required. The State reserves the right to furnish materials and equipment required for performance of the changes, and the Contractor shall have no claim for costs or mark-ups on such materials and equipment.

.3 Construction Equipment:

.1 Compensation for construction equipment shall include the necessary costs for use of construction equipment directly required for performance of the changes. Any use for less than 30 minutes shall be considered one-half hour. No costs will be allowed for time while construction equipment is inoperative, idle, or on stand-by, for any reason, unless such times have been approved in advance by the State. Rental time for construction equipment moved by its own power shall include the time required to move construction equipment to the Work site from the nearest available source for rental of such equipment, and time required to return such equipment to the source. If construction equipment is not moved by its own power, loading and transportation costs will be paid in lieu of such rental time. Neither moving time nor loading and transportation costs will be allowed if the construction equipment is used for any work other than the changes. No allowance will be made for individual pieces of construction equipment and tools having a replacement value of $500 or less. No construction equipment costs will be recognized in excess of rental rates established by distributors or equipment rental agencies in the locality for performance of the changes.

.2 Unless otherwise approved by the State, the allowable rate for use of construction equipment shall constitute full compensation to the Contractor for cost of fuel, power, oil, lubrication, supplies, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, labor except for construction equipment operators and any and all costs to the Contractor incidental to the use

of such construction equipment.

.4 Mark-Ups for Added Work:

.1 General: The following allowance for mark-ups for performance of the changes shall constitute full compensation for additional field and home office overhead, profit, insurance, taxes (excluding sales taxes for materials incorporated into the project), and bonds, and other costs not covered under Clauses 6.2.2.1 through 6.2.2.3.

.2 Contractor: When work is added, the Contractor may claim mark-up in addition to authorized allowable costs, a reasonable sum as compensation for the items identified in 6.2.2.4.1 above, subject to proof of entitlement based on actual job costs, actual job experience, the Contractor's bidding data, and industry custom and practice. Under no circumstance can this sum exceed the following percentages:

.1	Contractor Labor	:	21 percent, includes bond cost.
.2	Contractor Materials and Equipment	:	16 percent, includes bond cost.
.3	Subcontractor Work	:	6 percent of Subcontractor's costs, includes bond cost.

.1 Calculations of the Contractor's allowable 6 percent mark-up of the Subcontractor's Work shall not include the Subcontractor's allowable mark-up. Compounding of mark-up is not allowed.

.3 Subcontractors: When work is added, the Subcontractor may claim mark-up in addition to authorized allowable costs, a reasonable sum as compensation for the items identified in 6.2.2.4.1 above, subject to proof of entitlement based on actual job costs, actual job experience, the Subcontractor's bidding data, and industry custom and practice. Under no circumstance can this sum exceed the following percentages:

.1	Subcontractor Labor	:	20 percent
.2	Subcontractor Materials and Equipment	:	15 percent

.3 The aggregate mark-ups for all Subcontract tiers shall not exceed 20 percent for labor and 15 percent for materials and equipment. Compounding of mark-up is not allowed.

.5 For Deleted Work: When the State is entitled to a credit for deleted work, the credit shall include direct labor, materials, and supervision plus overhead of the Contractor or Subcontractor, as applicable for the deleted work. Deleted overhead shall be computed as no less than 5 percent of the direct labor, materials, and supervision, and should reflect the actual savings to the Contractor resulting from the deletion based upon actual job prices for the work at issue, actual job experience, the Contractor's bidding data for the project and industry custom and practice. For example, if a $10,000 item of work is deleted, the credit to the State would be no less than $10,500.

.6 For Combination of Added and Deleted Work: For Change Orders that involve both added and deleted work, the Contract Sum will be adjusted based on the following computation: Cost before mark-ups of added and deleted work shall each be separately estimated. If a difference between costs results in an increase to the Contract Sum, a mark-up for added work shall be applied to the difference. If a difference in costs results in a decrease, then the 5 percent credit to the State for deleted overhead set forth above shall be applied to the difference.

.7 General Limitations: Costs to the Contractor for changes which exceed market values prevailing at the time of the change will not be allowed unless the Contractor establishes that all reasonable means for performance of the changes at prevailing market values have been investigated and the excess cost could not be avoided. Notwithstanding actual charges to the Contractor on work performed or furnished by others, no mark-ups will be allowed in excess of those specified in Clause 6.2.2.4 above.

6.2.3 Cost Disallowance: Costs which will not be allowed or paid in Change Orders or Claim settlements under this Contract include, but are not limited to, interest cost of any type other than those mandated by statute; Claim preparation or filing costs; legal expenses; the costs of preparing or reviewing proposed Change Orders or Change Order proposals concerning Change Orders which are not issued by the State; lost revenues; lost profits; lost income or earnings; rescheduling costs; costs of idled equipment when such equipment is not yet at the site or has not yet been employed on the Work; lost earnings or interest on unpaid retainage; claims consulting costs; the costs of corporate officers or staff visiting the site or participating in meetings with the State; any compensation due to the fluctuation of foreign currency conversions or exchange rates; or loss of other business.

6.3 **ACCEPTANCE OF CHANGE ORDERS:** The Contractor's written acceptance of a Change Order shall constitute final and binding agreement to the provisions thereof and a waiver of Claims in connection therewith, whether direct, indirect, or consequential in nature.

6.4 **EFFECT ON SURETIES:** Alterations, extensions of time, extra and additional work, and other changes authorized by the Contract Documents may be made without securing consent of Surety(s) on Contract Bonds.

ARTICLE 7 - TIME

7.1 NOTICE TO PROCEED

7.1.1 The Contractor will be notified of the Contract start date as stated in the Notice to Proceed. Notwithstanding other provisions of the Contract, the State will not be obligated to accept or to pay for work furnished by the Contractor prior to the start date stated in the Notice to Proceed whether or not the State has knowledge of the furnishing of such work. The Contractor shall not be allowed on the site of the Work until the Contractor's Contract bonds and certificates of insurance comply with requirements of the Contract.

7.1.2 Work under the Contract shall be conducted in accordance with Paragraph 3.10. The Contractor shall not begin any Work until authorized in writing by the State.

7.2 **CONTRACT TIME:** The Contract Time is the period set forth in Document 00 73 00, Supplementary Conditions. The start and completion dates will be stated in a Notice to Proceed. It is essential that the Project be completed within the time fixed for Completion in Document 00 73 00 or liquidated damages will be assessed for delay. All portions of the Work shall be completed and shall be ready for full use by the State on, or prior to, the date of Completion.

7.2.1 Time is of the essence in this Contract.

7.3 **LIQUIDATED DAMAGES:** For every day that the Work remains unfinished after the time fixed for Completion in the Contract Documents, as modified by any approved extension of time, damage will be sustained by the State. Because of the difficulty in computing actual material loss and disadvantages to the State, it is determined in advance that the Contractor will pay the State the amount of damages set forth in the Agreement, as representing a reasonable forecast of actual damages which the State will suffer by failure of Contractor to complete the Work within the time fixed for Completion in the Contract. Execution of the Agreement shall constitute acknowledgment by the Contractor that the Contractor agrees that the State will actually suffer damages in the amount fixed for every Day during which Completion of the Work is avoidably delayed beyond the time fixed for Completion in the Contract.

7.4 TIME EXTENSIONS

7.4.1 Request for Time Extension: In the event the Contractor requests an extension of Contract Time for unavoidable delay, the Contractor shall furnish such justification and supporting evidence as the State may deem necessary for the determination as to whether the Contractor is entitled to an extension of Contract Time. The Contractor shall submit justification in writing no later than 7 days after the initial occurrence of any delay. The justification shall be based on the Official Progress Schedule as updated at the time of occurrence of the delay or execution of work related to any changes to the scope of the Work. The justification shall include, but is not limited to the following information:

.1 Duration to perform activity(ies) relating to changes in the Work and resources (manpower, equipment, material, etc.) required to perform these activities within the stated duration.

.2 Logical ties to the Official Progress Schedule for proposed changes or delay showing activity(ies) in the schedule start or completion dates are affected by the change or delay.

7.4.2 The State, upon receipt of such justification and supporting evidence, shall make its finding of fact. The State's decision shall be final and conclusive and the State will advise the Contractor in writing of such decision. If the State finds that the Contractor is entitled to an extension of Contract Time, the State's determination as to the total number of extension days shall be based upon the latest updated version of the Official Progress Schedule. Such data will be included in the next monthly updating of the schedule.

7.4.3 Time Extensions: For delays that the State agrees are unavoidable, and are Justified in accordance with Subparagraph 7.5.2, the Contractor shall, pursuant to the Contractor's application, be allowed an extension of time beyond the Contract Time. During such extension of time, neither extra compensation for engineering and inspection nor liquidated damages will be charged to the Contractor. Time extensions shall be granted only for delays or changes that extend the Completion date, based on the latest accepted updated version of the Official Progress Schedule. Time extensions for delays and changes shall not exceed one day for each day that the Contract Completion date of the Official Progress Schedule is extended by this change or delay.

7.5 DELAYS IN COMPLETION OF THE WORK

7.5.1 Notice of Delays: Whenever the Contractor foresees delay in the continuance and Completion of the Work, or immediately upon the occurrence of any delay which the Contractor regards as unavoidable, the Contractor shall notify the State in writing, in a separate notice of the delay. The Contractor's notice shall include the probability of the occurrences of such delay and its cause in

order that the State may take immediate steps to prevent the occurrence or continuance of the delay. If the delay cannot be prevented, the State will determine whether the delay is unavoidable and to what extent continuance and Completion of the Work is anticipated to be delayed.

.1 The Contractor shall make no claim for delay not called to the attention of the State in writing, at the time of its occurrence.

.2 Delay in the continuance of parts of the Work that does not prevent or delay the continuance of other parts of the Work or the Completion of the whole Work within the Contract Time shall be deemed to constitute neither avoidable delays nor unavoidable delays, within the meaning of the Contract. Such delay will be considered Unjustified and no extension to the Contract Time and/or additional compensation will be granted.

7.5.2 Justified Delay: Justified Delay in the continuance or Completion of the Work shall include delays which result from causes beyond the control of the Contractor and which could not have been avoided by the exercise of due care and diligence on the part of the Contractor or the Contractor's Subcontractors. Delay in Completion of the Work due to Contract modifications ordered by the State and unforeseeable delays in continuance or completion of the work of other contractors employed by the State may be considered Justified Delays insofar as they interfere with the Contractor's Completion of the Work within the Contract Time. Delays due to normal weather conditions which prevent the Contractor from proceeding with the controlling item on the Official Progress Schedule will not be regarded as a Justified Delay.

.1 Justified Delay will result in an extension beyond the Contract Time in accordance with Paragraph 7.4.

.2 Justified Delay that includes Contract modifications ordered by the State may entitle the Contractor to extra compensation in accordance with the provisions of Article 6.

.3 Delay that results from causes beyond the control of the State and is determined by the State to be the Contractor's responsibility shall be considered Unjustified and will result in no extension in the Contract Time or extra compensation. The State's decision shall be final and conclusive.

.4 The State will determine the net difference between overlapping or concurrent Justified Delays and Unjustified Delays and whether the Contractor is entitled to any extension in the Contract Time and/or extra compensation. The State's decision shall be final and conclusive.

7.5.3 Weather Delays: If weather conditions are the basis for delays in the continuance or completion of the Work, such delay shall be documented by 5 year climatological data obtained by the Contractor, from the nearest nationally recognized reporting station to the Work site, substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions had an adverse effect on the scheduled construction. The State will not be responsible for additional costs of the Contractor caused by weather delays, including, but not limited to, costs of extended overhead.

7.6 ACCELERATION

7.6.1 The State reserves the right to accelerate the Work of the Contract. In the event that the State directs acceleration, such directive will be only in written form. The Contractor shall keep cost and other Project records related to the acceleration directive separately from normal Project costs and records, and shall provide a written record of acceleration cost to the State on a daily basis.

7.6.2 In the event that the Contractor believes that some action or inaction on the part of the State constitutes an acceleration directive, the Contractor shall immediately notify the State in writing that the Contractor considers the actions an acceleration directive. This written notification shall detail the circumstances of the acceleration directive. The Contractor shall not accelerate work efforts until the State responds to the written notification. If acceleration is then directed or required by the State, cost records referred to above shall be maintained by the Contractor and provided to the State on a daily basis.

7.6.3 In order to recover additional costs due to acceleration, the Contractor shall document that additional expenses were incurred and paid by the Contractor. Labor costs recoverable will be only overtime or shift premium costs or the cost of additional laborers brought to the site to accomplish the accelerated work effort. Equipment costs recoverable will be only the cost of added equipment mobilized to the site to accomplish the accelerated work effort.

ARTICLE 8 - PAYMENTS AND COMPLETION

8.1 **SCHEDULE OF VALUES**: Before the first payment request, the Contractor shall submit to the State a Schedule of Values allocated to portions of the Work, included with the Contractor's Progress Schedule, and supported by such data to substantiate the accuracy as the State may require. This Schedule of Values, unless objected to by the State, shall be used as a basis for progress payments.

8.2 **TIMELINESS OF PAYMENTS**

8.2.1 Upon receipt of a payment request by the designated State's Representative with updated Progress Schedule from the Contractor, the State will review same to determine if it is a proper payment request based on the approved Schedule of Values. Any payment request determined by the State not to be suitable for payment shall be modified and processed in accordance with the State's assessment or returned to the Contractor for resubmittal. The reason(s) the payment request was deemed unsuitable shall be stated in writing.

8.2.2 Actual payment request submittal date shall be established by the State. Thereafter, the payment request submittal date will be monthly on the same date.

8.2.3 The State will make progress payments pursuant to Public Contract Code, Section 10261.5.

8.3 **RETENTIONS**

8.3.1 Upon submittal and receipt of a monthly payment request in accordance with Paragraph 8.2 above, the following shall apply:

.1 The Contractor's payment request shall include the total amount of Work completed to date, including materials as verified by the State, furnished and delivered on the Project site, not used, or in a secure off-site facility, pursuant to Public Contract Code, Section 10261. All materials included in the Contractor's payment requests furnished and delivered on the Project site, not used, and /or in a secure off-site facility shall be used exclusively for the Project. It shall be the sole responsibility of the Contractor to maintain, protect and secure such materials.

.2 The State shall retain not less than 5 percent of the estimated value of Work completed.

8.3.2 Securities in Lieu of Retention: At the request and expense of the Contractor, and in accordance with Public Contract Code, Section 10263, the Contractor may provide securities in lieu of retention.

8.4 **ASSIGNMENT OF CONTRACT FUNDS:** The Contractor may assign moneys due or to become due under the Contract, through an amendment to the Contract. Any assignment of moneys earned by the Contractor shall be subject to proper retention in favor of the State and to deductions provided for in the Contract. Moneys withheld, whether assigned or not, are subject to being used by the State to the extent permitted by law, for the Completion of the Work in the event that the Contractor is in default of the Contract.

8.5 **OCCUPANCY BY THE STATE PRIOR TO COMPLETION OF THE WORK**

8.5.1 The State reserves the right to occupy all or any part of the Project prior to Completion of the Work, upon written notice. Such occupancy or use is herein referred to as Beneficial Occupancy. In this event, the Contractor shall be relieved of responsibility to the State for liability arising out of such occupancy by the State. Nevertheless, the Builder's Risk Coverage must remain in effect, with either a "consent to occupy" endorsement or a waiver of occupancy endorsement, with no right of recovery against the State.

8.5.2 The State's Beneficial Occupancy does not constitute Completion of the Work or Acceptance of the Work by the State, or any portion of the Work, nor will it relieve the Contractor of responsibility for correcting defective Work or materials found at any time before Acceptance of the Work, as set forth in Article 12 or during the Guarantee period as set forth in Paragraph 3.5, or after the State's acceptance, as set forth in Subparagraph 8.6.1. However, when the Project includes separate buildings, and one or more of the buildings is entirely occupied by the State, then upon written request by the Contractor and by written consent from the State, the Guarantee period will commence to run from the date of the State's occupancy of such building or buildings.

8.6 **ACCEPTANCE OF THE WORK AND FINAL PAYMENT**

8.6.1 When the Contractor considers the Work complete, the Contractor shall request a final inspection in writing to be conducted by the State.

.1 The Contractor shall request this final inspection only when all Work, including deficient items identified on previous inspections, have been completed and deliverables delivered as noted in the Project Manual, Section 01 77 00.

.2 The State Representative shall conduct a final inspection within 14 days of receipt of a written request from the Contractor for final inspection.

.3 If, after the inspection, the State Representative determines that the Work is complete, the State Representative will establish a date for Completion of the Work. The State Representative will then recommend to the Director of the Department of General Services, or the Director's designee, to accept the Work within 60 days from the

date of Completion of the Work.

.4 Upon Acceptance of the Work by the Director:
   a) The Retention held by the State will be released, and
   b) The Contractor will be relieved of the duty of maintaining and protecting the Work.

.5 If the State determines that the Work is not complete, the Contractor will be notified in writing of deficiencies. After correcting all deficiencies the Contractor shall again initiate the procedures for final inspection as set forth above. If the process of re-inspection and correction of deficiencies goes beyond the Contract Time, the Contractor shall be assessed liquidated damages.

.6 Determination by the State that the Work is complete or Acceptance of the Work will not bar any Claim against the Contractor pursuant to Paragraph 3.5.

8.6.2 Upon Acceptance of the Work, the State will submit a final statement to the Contractor:

.1 The final statement shall take into account the Contract Sum as adjusted by any Change Orders, amounts already paid to the Contractor, sums to be withheld for incomplete Work, liquidated damages, stop notices, and for any other cause under the Contract.

.2 A warrant in the amount of the sum due the Contractor, if any, will be issued.

.3 If the Contractor owes any amount to the State, the final statement shall serve as an invoice to the Contractor.

8.6.3 The Contractor is required to pay Subcontractors from which a Retention has been withheld within 7 days of receipt from the State of Retention proceeds.

8.6.4 The Contractor has 30 days after receipt of the final statement to file a Claim with the State.

.1 All Claims shall comply with the requirements of Subparagraph 9.1.2.

.2 Failure to file a Claim within the 30 day period constitutes a failure to diligently pursue and exhaust the required administrative procedures set forth in the Contract. Such failure shall constitute waiver of additional rights to compensation under the Contract or the right to request Equitable Adjustment.

.3 If the Contractor does not file a Claim within the 30 day period, the final warrant made by the State will become a complete and final settlement between the State and the Contractor.

8.7 **INTEREST:** Payments due and unpaid under the Contract shall earn interest pursuant to Public Contract Code, Sections 7107 and 10261.5.

ARTICLE 9 - DISPUTES AND CLAIMS

9.1 DISPUTE AND CLAIM PROCEDURES

9.1.1 Dispute as to Contract Requirements: When the Contractor and the State fail to agree whether or not any work is within the scope of Contract requirements, the Contractor shall immediately perform such work upon receipt of a written notice to do so by the State. Within 14 days after receipt of such notice to perform disputed work, the Contractor may submit a written protest to the State, specifying in detail the Contract requirements that were exceeded, and approximate change in cost resulting so that the State will have notice of a potential Claim. Failure to submit a protest within the specified period shall constitute a waiver of any and all rights to an adjustment in Contract Sum and Contract Time due to such work, and the Contractor thereafter shall not be entitled to adjustment of Contract Sum or Contract Time. For any such work that is found to exceed Contract requirements, there shall be an adjustment in Contract Sum and Contract Time on same basis as any other change in the Work.

.1 The Contractor shall provide supporting data and shall provide and maintain records of costs attributable to Disputes in similar manner as for Change Orders in Article 6.

.2 The State's Representative and the Contractor's Superintendent will make every reasonable effort to resolve the Dispute prior to proceeding to the next step.

.3 Either the State or the Contractor may call a special meeting for the purpose of resolving the Dispute. Such a meeting will be held within 7 days of written request thereof.

.4 If the Dispute as to the Contract Documents has not been resolved, the Contractor shall, within 14 days after the special meeting, take one or more of the following actions:
   .1 submit additional supporting data requested by the State;
   .2 modify the initial Dispute; or
   .3 notify the State that the initial Dispute stands as is.

.5 If the Dispute has not been resolved within 7 days after the Contractor's action in response to Clause 9.1.1.4, another meeting may be scheduled, at the State's option, with senior management personnel of the State and the Contractor. The purpose of this meeting is to resolve the Dispute prior to proceeding to the action under

Subparagraph 9.1.2.

9.1.2 Claim Submission and Documentation: If a Dispute has not been resolved at the time of the State's final statement, the Contractor shall submit within 30 days a Claim along with detailed documentation required by Subparagraph 9.1.1 for the State's consideration.

.1 The Contractor shall furnish 3 certified copies of the required Claim documentation. The Claim documentation shall be complete when furnished. The evaluation of the Contractor's Claim will be based upon State records and the Claim documents furnished by the Contractor.

.2 Claim documentation shall conform to generally accepted accounting principles and shall be in the following format:

- .1 General Introduction
- .2 General Background Discussion
- .3 Issues
  - .1 Index of Issues (listed numerically)
  - .2 For each issue
    - .1 Background
    - .2 Chronology
    - .3 Contractor's position (reason for State's potential liability)
    - .4 Supporting documentation of merit or entitlement
    - .5 Supporting documentation of damages
    - .6 Begin each issue on a new page
- .4 All critical path method (CPM) schedules, both as-planned, monthly updates, schedule revisions, and as-built along with the computer disks of all schedules related to the Claim.
- .5 Productivity exhibits (if appropriate)
- .6 Summary of Issues and Damages

.3 Supporting documentation of merit for each issue shall be cited by reference, photocopies, or explanation. Supporting documentation may include, but shall not be limited to, General Conditions; General Requirements; technical Specifications; Drawings; correspondence; conference notes; Shop Drawings and submittals; Shop Drawing logs; survey books; inspection reports; delivery schedules; test reports; daily reports; subcontracts; fragmentary critical path method (CPM) schedules or time impact analyses; photographs; technical reports; requests for information; field instructions; and all other related records necessary to support the Contractor's Claim.

.4 Supporting documentation of damages for each issue shall be cited, photocopied, or explained. Supporting documentation may include, but shall not be limited to, documents related to the preparation and submission of the bid; certified, detailed labor records, including labor distribution reports; material and equipment procurement records; construction equipment ownership costs records or rental records; Subcontractor or vendor files and cost records; service cost records; purchase orders; invoices; Project as-planned and as-built cost records; general ledger records; variance reports; accounting adjustment records; and any other accounting materials necessary to support the Contractor's Claim.

.5 Each copy of the Claim documentation shall be certified by a responsible officer of the Contractor in accordance with the requirements of the Contract Documents.

.6 Should the Contractor be unable to support any part of the Claim, and it is determined that such inability is attributable to falsity of such certification or misrepresentation of fact or fraud on the part of the Contractor, the Contractor shall be liable to the State as provided for under California Government Code, Section 12650 et seq., known as the False Claims Act.

.7 The State will render a written decision to the Contractor relative to the Claim. The State's written decision shall be final and binding on the party(ies) but subject to arbitration. The State may withhold from the final payment an amount not to exceed 150 percent of the disputed amount. If there is a Surety and there appears to be a possibility of a Contractor's default, the State may, but is not obligated to, notify the Surety and request the Surety's assistance in resolving the controversy.

.8 All issue items to be included in the Complaint in Arbitration shall be a part of the Claim submitted with the required documentation under this Subparagraph 9.1.2. Issues not included in the Claim under Subparagraph 9.1.2 shall not be considered.

9.1.3 Arbitration: Any Claim filed in compliance with Subparagraph 9.1.2 not resolved by the above procedures shall be resolved by arbitration in accordance with the provisions of Public Contract Code Section 10240 et seq., and Title 1, California Code of Regulations, Section 1300 et seq., unless the State and the Contractor agree in writing to waive arbitration and proceed to litigation. Either party may initiate arbitration by filing a Complaint in Arbitration with the Office of Administrative Hearings in

Sacramento, California, in compliance with the requirements of Public Contract Code Section 10240, et seq., and Title 1, California Code of Regulations, Section 1300 et seq. Arbitration shall be conducted in Sacramento, California.

9.2 AUDIT AND ACCESS TO RECORDS

9.2.1 The Contractor shall maintain books, records, documents, and other evidence directly pertinent to the performance of the Work under this Contract, in accordance with generally accepted accounting principles and practices consistently applied. The Contractor shall also maintain all financial information and data used by the Contractor in the preparation or support of any cost submission, including the Contractor's original bid required for this Contract, or any Change Order, Claim, or other request for equitable adjustment, and a copy of the cost summary or information submitted to the State. The State's Representative shall have access upon 24 hours advance written notice, at all times during normal business hours, to such books, records, documents, financial information, and all other evidence for the purpose of inspection, audit, and copying. The Contractor shall, at no cost to the State, provide proper facilities for such access, inspection and copying purposes.

9.2.2 The Contractor agrees to make the provisions of Paragraph 9.2 applicable to this Contract, and Change Orders, Claims, or other requests for Equitable Adjustment affecting the Contract Time or Contract Sum. The Contractor agrees to include the provisions of Paragraph 9.2 in subcontracts and sub-subcontracts or purchase orders, at any tier, and make Paragraph 9.2 applicable to subcontracts, at any tier, in excess of $10,000, and to make the provisions of Paragraph 9.2 applicable to Change Orders, Claims, and other requests for Equitable Adjustment related to Project performance.

9.2.3 Audits conducted under Paragraph 9.2 shall be in accordance with general accepted auditing standards and established procedures and guidelines of the reviewing or audit agency.

9.2.4 The Contractor agrees to the disclosure of all information and reports resulting from access to records under the provisions of Paragraph 9.2, to the State, and other affected agencies.

9.2.5 Records under the provisions of Paragraph 9.2 shall be maintained and made available during the performance of the Work under this Contract until 3 years past final payment, and until final settlement of all Disputes, Claims, or litigation, whichever occurs later. In addition, those records which relate to any portion of this Contract, to any Change Order, to any Dispute, to any litigation, to the settlement of any Claim arising out of such performance, or to the cost or items to which an audit exception has been taken, shall be maintained and made available until final payment or final resolution of such Dispute, litigation, Claim, or exception, whichever occurs later.

9.2.6 The right of access provisions of Paragraph 9.2 applies to financial records pertaining to this Contract and Change Orders and Claims. In addition, this right of access applies to records pertaining to all contracts, Change Orders, and Contract Amendments:

.1 To the extent the records pertain directly to Contract performance;
.2 If there is any indication that fraud, gross abuse, or corrupt practices may be involved;
.3 If the Contract is terminated for default or convenience.

9.2.7 Access to records is not limited to the required retention periods. The authorized State Representatives shall have access to records at any reasonable time for as long as the records are maintained.

9.2.8 Further, the Contractor agrees to include a similar right of the State to audit records and interview staff in any subcontract related to performance of this Agreement, in regards to the Disabled Veterans Business Enterprise (DVBE) Program.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY OF PERSONS AND PROPERTY

10.1.1 The Contractor shall initiate, maintain and supervise -safety precautions and programs in connection with the performance of the Work.

10.1.2 The Contractor shall take precautions for safety and provide protection to prevent damage, injury or loss to:

.1 Employees working under the Contract and other persons who may be affected thereby;
.2 The Work and materials and equipment to be incorporated therein, whether in storage on or off the Project site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
.3 Other property at the Project site, or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities, except as otherwise noted or specified.

10.1.3 The Contractor shall comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on the safety of persons or property, or their protection from damage, injury or loss.

10.1.4 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying the State, other Owners (other than the State) and users of adjacent sites and utilities.

10.1.5 The Contractor shall comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities regarding the storage and/or use of explosives or other hazardous materials or equipment necessary for execution of Work. The Contractor shall employ properly qualified personnel for supervision of same.

10.1.6 The Contractor shall remedy damage and loss to property referred to in Clauses 10.1.2.2 and 10.1.2.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Clauses 10.1.2.2 and 10.1.2.3. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.19.

10.1.7 The Contractor shall not permit any part of the Work or Project site to be loaded so as to endanger its safety.

10.1.8 When conditions of the Work, in the judgment of the State, present risk of injury or death to persons or property damage, the State, may direct the Contractor, at the Contractor's sole expense, to close down the Work and not commence work again until dangerous conditions are eliminated.

10.1.9 The Contractor, at the Contractor's own cost, shall rebuild, repair, restore and make good damages to any portion of the Work affected by such causes before Acceptance of the Work.

10.2 **EMERGENCIES:** In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's sole discretion, to prevent any threatened damage, injury or loss. Additional compensation or extension of Contract Time claimed by the Contractor because of an emergency will be reviewed as provided in Article 6.

10.3 **DRUG-FREE WORKPLACE**

10.3.1 By signing the Agreement, the Contractor certifies, under penalty of perjury under the laws of the State of California, that the Contractor will comply with the requirements of the Drug-Free Workplace Act of 1990 (Government Code, Section 8350 et seq.), and will provide a drug-free workplace by taking the following actions:

.1 Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying actions to be taken against employees for violations.

.2 Establish a Drug-Free Awareness Program to inform employees about:

.1 The dangers of drug abuse in the workplace;

.2 The person's or company's policy of maintaining a drug-free workplace;

.3 Any available counseling, rehabilitation, and employee assistance programs; and,

.4 penalties that may be imposed upon employees for drug abuse violations.

.3 Provide, as required by Government Code, Section 8355(c), that every employee who works under the Contract will:

.1 receive a copy of the company's drug-free workplace policy statement; and

.2 agree to abide by the terms of the company's statement as a condition of employment.

ARTICLE 11 - INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE

11.1.1 General Insurance Requirements:

.1 Contractor shall procure and maintain insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder and the results of that work by the Contractor, its agents, representatives, employees or subcontractors.

.1 Contractor shall furnish the State with original certificates and endorsements effecting coverage required by this clause. All certificates and endorsements are to be received and approved by the State before work commences.

.2 The State reserves the right to require complete, certified copies of all required insurance policies, including endorsements affecting the coverage required by these specifications at any time.

.2 Insurance Companies shall be acceptable to Department of General Services (DGS) and Office of Risk and Insurance Management (ORIM). Insurance is to be placed with insurers with a current A.M. Best's rating of no less than A-VI. Exception may be made for the State Compensation Insurance Fund. If self-insured, review of financial information may be required.

.3 Except as otherwise provided for Builders Risk/Installation Floater under Clause 11.1.2.4, all coverage shall be in force until the Acceptance of the Work by the Director of DGS. If the insurance expires, the Contractor shall immediately provide a new current certificate or be declared in breach of Contract. The State reserves the right to withhold all progress and retention payments until the breach is cured to the satisfaction of the State. Renewal insurance certificates must be tendered to the State prior to or exactly at the expiration of the previous insurance certificate. There shall be no gap in insurance coverage. This renewed insurance shall be in accordance with the terms of the Contract.

.4 Insurance policies shall contain a provision that coverage will not be cancelled without 30 days prior written notice to the State.

.5 The Contractor shall be responsible for any deductible or self-insured retention contained within the insurance.

.6 In the event the Contractor fails to keep in effect at all times the specified insurance coverage, the State may, in addition to the remedies noted in Article 11.1.1.3 above and any other remedies it may have, remove the Contractor from the work site and/or may terminate this Contract upon the occurrence of such event, subject to the provisions of this Contract. In the event, the State elects to remove the Contractor from the work site, the Contractor will not be entitled to additional days or compensation.

.7 Any insurance required to be carried shall be primary.

.8 Minimum Scope of Insurance - Coverage shall be at least as broad as:

.1 Insurance Services Office Commercial General Liability coverage (occurrence Form CG 0001). The insurance Certificate shall show the GL form number.

.2 Insurance Services Office Form Number CA 0001 covering Automobile Liability, "any auto", or "scheduled, hired and nonowned".

.9 The State reserves the right to require the Contractor to provide the subcontractors' insurance certificates and policies, when so directed by the State.

11.1.2 Insurance Requirements: The Contractor shall furnish to the State evidence of the required insurance as follows:

.1 Commercial General Liability: The Contractor shall maintain commercial general liability with limits of not less than $5,000,000 per occurrence for bodily injury and property damage liability combined. If Commercial General Liability insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit shall be twice the required occurrence limit. If the aggregate applies "per project or location", it shall so state on the certificate. The policy shall include coverage for liabilities arising out of premises, operations, independent contractors, products, completed operations, personal and advertising injury, and liability assumed under an insured contract. This insurance shall apply separately to each insured against whom claim is made or suit is brought subject to the Contractor's limit of liability. The policy shall include the Department of General Services and the State of California, its officers, agents, and employees, as additional insureds, but only insofar as the operations under the Contract are concerned.

.1 Additional Insured coverage shall be provided in the form of an insured endorsement (CG 20 10 11 85 r equivalent) to the contractor's insurance policy. The endorsement must be attached to the certificate.

.2 Deductibles and Self-Insured Retentions (for Commercial General Liability): Any deductibles or self-insured retentions must be declared to and approved by the State. At the option of the State, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the State of California and the Department of General Services, its officers, agents, employees and servants or the Contractor shall provide a financial guarantee satisfactory to the State guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

.2 Automobile Liability: The Contractor shall maintain motor vehicle liability with limits of not less than $1,000,000 per accident for bodily injury and property damage. The State is to be covered as additional insured with respect to liability arising out of automobiles owned, leased, hired or borrowed by or on behalf of the contractor.

.3 Workers' Compensation: The Contractor shall maintain statutory workers' compensation and employer's liability coverage for all its employees who will be engaged in the performance of the Contract, including special coverage extensions where applicable as required by the State of California. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the State for all work performed by the contractor, its employees, agents and subcontractors. Except for State Fund, all subrogation waiver endorsements shall be on a separate form attached to the certificate. The Contractor shall maintain Employer's Liability coverage of $1,000,000 per accident for bodily injury or disease.

.4 Builders Risk/Installation Floater: The Contractor shall maintain in force, at its own expense, Builders Risk/Installation Floater covering the Contractor's labor, materials, and equipment to be used for completion of the Work performed under this Contract against all risks of direct physical loss, excluding earthquake and flood, for an amount equal to the full amount of the Contract Sum.

.1 The Contractor agrees as a provision of the contract to waive all rights of recovery against the State.

.2 The State of California, Department of General Services shall be a named insured or additional insured under the policy.

.3 The policy shall have a loss payable clause in favor of the State of California, Department of General Services.

.4 The requirement for maintaining the Builders Risk/Installation Floater shall be in full force at all times during the entire duration of the Contract Time without any gaps, delays or breaks in coverage. This includes Beneficial Occupancy and authorized adjustment for time extensions. Coverage shall be maintained until Completion of the Work, except for delivery of as-built drawings, operation and maintenance manuals, guarantees, warranties, spare parts, reports and certifications as noted in the Closeout Procedures section of the Project Manual and as determined by the State's Representative in writing.

11.1.3 Neither the State, nor any officer or employee of the State, shall be liable for any loss or damage that may happen to the Work, or any part thereof; nor to any of the materials or other items used or employed in performing the Work; nor for injury to any person or persons, either workers or the public, for damage to property from any cause which might have been prevented by the Contractor, or the Contractor's employees or agents, against all of which injuries or damages the Contractor shall properly guard. The Contractor shall indemnify and hold harmless the State, and all officers and employees of the State, from all suits, actions or claims brought for, or on account of injuries or damages received or sustained by any person or persons, by or from the Contractor, the Contractor's employees or agents, in construction of the Work, or by or in consequence of the Contractor's failure to properly guard the same, or by or as a result of any act or omission of the Contractor, the Contractor's employees or agents. In addition to any remedy authorized by law, moneys due the Contractor under the Contract, as considered necessary by the State, may be retained until disposition has been made of such suits, actions, or claims for damages; however, this provision shall not be construed as precluding the State from enforcing any right of offset the State may have to any such moneys.

11.2 **NO PERSONAL LIABILITY:** Neither the State, nor any other officer or employee of the State will be personally responsible for liabilities arising under the Contract.

11.3 **PERFORMANCE BOND AND PAYMENT BOND**

11.3.1 The Contractor shall furnish bonds, each in the amount of 100 percent of the Contract Sum, covering faithful performance of the Contract and payment of obligations arising thereunder, as stipulated in the bidding requirements or as specifically required in the Contract Documents.

11.3.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bond(s) or permit a copy to be made.

ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

12.1 UNCOVERING AND CORRECTION OF WORK

12.1.1 If a portion of the Work is covered prior to the State's review, it shall, if requested in writing by the State, be uncovered for the State's observation and replaced at the Contractor's expense without change in the Contract Time.

12.1.2 The Contractor shall notify the State 2 working days prior to covering any work.

12.2 CORRECTION OF WORK

12.2.1 The Contractor shall promptly correct work rejected by the State or Work failing to conform to the requirements of the Contract Documents, whether or not fabricated, installed or completed. The Contractor shall bear the costs of correcting such rejected work, including additional testing and inspections required and compensation for the State's services and expenses made necessary thereby.

12.2.2 Notwithstanding Paragraph 3.5, in the event of an emergency constituting an immediate hazard to the health or safety of any persons or property, the State may undertake, at the Contractor's expense and without prior notice, work necessary to correct such hazardous condition(s) arising from work performed by the Contractor that is not in conformance with the requirements of the Contract Documents.

12.2.3 The Contractor shall remove from the Project site portions of the Work that are not in accordance with the requirements of the Contract Documents, and are neither corrected by the Contractor nor accepted by the State.

12.2.4 If the Contractor fails to correct nonconforming work, as per Paragraph 3.5, the State may correct the nonconforming work in accordance with Paragraph 2.3. If the Contractor does not proceed with correction of such nonconforming work, within such time fixed by written notice from the State, the State may remove and store the salvable materials articles and/or equipment at the Contractor's expense. If the Contractor does not pay all costs of such removal and storage within 14 days after written notice, the State may, upon 14 additional calendar days written notice, sell such materials articles and/or equipment at an auction or private sale, and shall account for the proceeds thereof, after deducting costs and damages that would have been borne by the Contractor, including compensation for the State's services and expenses made necessary thereby. If the proceeds of a sale do not cover all costs that the Contractor would have borne, the Contract Sum shall be reduced by the deficiency. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the State.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged Work executed by the State or separate contractors, whether fully completed or partially completed, which is caused by the Contractor's correction or removal of Work that is not in accordance with requirements of the Contract Documents.

12.2.6 Nothing contained in this Paragraph 12.2 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have in the Contract Documents. Establishment of the time period of 1 year, as described in Subparagraph 3.5.1, relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with requirements of the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

12.3 **ACCEPTANCE OF NONCONFORMING WORK:** If the State prefers to accept any or all of the Work that is not in accordance with requirements of the Contract Documents, the State may do so instead of requiring its correction and/or removal, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment to the Contractor has been made.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1 **GOVERNING LAW:** The Contract shall be governed by the law of the State of California.

13.2 **SUCCESSORS AND ASSIGNS:** The Contract binds the Contractor, the Contractor's partners, successors, assigns and legal representatives to the State in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations in the Contract Documents.

13.3 **WRITTEN NOTICE:** Written notice shall be deemed to have been duly served if delivered in person to the individual; or a member of the firm or entity; or to an officer of the corporation for which it was intended; or if delivered to or sent by US mail to the last business address known to the party giving notice.

13.4 **CONTRACTOR'S USE OF COMPUTER SOFTWARE:** The Contractor, by signing the Agreement, certifies that it has appropriate systems and controls in place to ensure that State funds will not be used in the performance of the Contract for the acquisition, operation or maintenance of computer software in violation of copyright laws.

13.5 **INDEPENDENT CONTRACTOR:** Contractor, and the agents, subcontractors, and employees of the Contractor, in the performance of this Contract, shall act in an independent capacity and not as officers or employees or agents of the State.

13.6 **UNENFORCEABLE PROVISIONS:** In the event that any provision of this Contract is unenforceable or held to be unenforceable, then the parties agree that all other provisions of this Contract have force and effect and shall not be affected thereby.

13.7 **EXPATRIATE CORPORATIONS:** Contractor herby declares that it is not an expatriate corporation or subsidiary of an expatriate corporation within the meaning of Public Contract Code Section 10286 and 10286.1, and is eligible to contract with the State.

13.8 **DOMESTIC PARTNERS:** For Contracts executed or amended after July 1, 2004, the Contractor may elect to offer domestic partner benefits to the Contractor's employees in accordance with Public Contract Code Section 10295.3. However, the Contractor cannot require an employee to cover the costs of providing any benefits which have otherwise been provided to all employees regardless of marital or domestic partner status.

13.9 **AIR OR WATER POLLUTION VIOLATION:** Under the State laws, the Contractor shall not be: (1) in violation of any order or resolution not subject to review promulgated by the State Air Resources Board or an air pollution control district; (2) subject to cease and desist order not subject to review issued pursuant to Section 13301 of the Water Code for violation of waste discharge requirements or discharge prohibitions; or (3) finally determined to be in violation of provisions of federal law relating to air or water pollution.

13.10 **CERTIFICATION BY CONTRACTOR OF DISABLED VETERAN BUSINESS ENTERPRISE/SMALL BUSINESS PARTICIPATION**

13.10.1 If, for this agreement, the Contractor made a commitment to achieve disabled veteran business enterprise (DVBE) participation, the Contractor must certify in writing to the State, the total amount the Contractor received under the contract, the name and address of the DVBE firms that participated in the performance of the contract, the amount each DVBE received from the Contractor, that all payments have been made to the DVBE and the actual percentage of DVBE participation achieved. Additionally, if for this agreement, the Contractor made a commitment to achieve 25% Small Business participation, the Contractor must certify in writing to the State, the actual percentage of Small Business participation that was achieved. The Contractor is instructed to comply with the procedures stated in CLOSEOUT PROCEDURES, Section 01 77 00. This certification shall be completed pursuant to Section 999.5 of the Military and Veterans Code (M&VC) and Section 14841 of the Government Code. A person or entity that knowingly provides false information shall be subject to a civil penalty for each violation.

END OF DOCUMENT

DOCUMENT 00 73 00
SUPPLEMENTARY CONDITIONS

Requirements included herein supplement DOCUMENT 00 72 00 - GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION.

1. ARTICLE 1 – GENERAL PROVISIONS

Paragraph 1.1, DEFINITIONS

Add the following definition:

Construction Manager: A consultant firm, Vanir has been retained for this Project by the State to assist the Department of General Services.

Hazardous Materials: These materials include but are not limited to products and materials containing: Asbestos, Lead, PCB's, Petroleum fuels and lubricants (including chemical additives), oxidizers, corrosives, solvents, acids and carcinogens.

2. ARTICLE 3 – CONTRACTOR

Paragraph 3.2, SUPERVISION AND CONSTRUCTION PROCEDURES

Delete Subparagraph 3.2.5 in its entirety and replace it with new Subparagraph 3.2.5 as follows:

3.2.5 Until Acceptance of the Work, the Contractor shall have the charge and care thereof, and shall bear risk of injury or damage to any part of the Work by action on the elements (except for an Act of God, or natural disaster as proclaimed by the State or Federal Government provided that the loss does not involve Contractor negligence and if the Work damaged is built in accordance with the Contract and applicable building standards), or from any other reason except for such damages as are directly caused by acts of the Federal or State Government and the public enemy, except as provided in Paragraph 8.5.

Paragraph 3.3, LABOR AND MATERIALS

Delete Subparagraph 3.3.3 in its entirety and replace it with new Subparagraph 3.3.3 as follows:

3.3.3. Prevailing Wage: The Contractor shall comply with Labor Code Sections 1774 and 1775. Pursuant to Section 1774, the Contractor and every subcontractor, regardless of tier, shall pay not less than the specified prevailing wage rates to all workers employed in the execution of the Contract. In accordance with Section 1775, the Contractor shall forfeit to the State up to $200 for each day, or portion thereof, for each worker paid less than the prevailing wage rates for the work or craft in which the worker is employed for any work executed under the Contract by the Contractor or by any subcontractor, regardless of tier, in violation of the provisions of the Labor Code; and, in particular, Labor Code Sections 1770 to 1780, inclusive. In addition to such forfeiture, the difference between such stipulated prevailing wage rates and the amount paid to each worker for each day, or portion thereof, shall be paid to each underpaid worker by the Contractor. This provision shall not apply to properly registered apprentices.

.1 Pursuant to Labor Code, Section 1770, the Director of the Department of Industrial Relations has ascertained the general prevailing rate of per diem wages and a general prevailing rate for legal holiday and overtime work for each craft required for execution of the Contract. The Contractor shall obtain copies of the prevailing rate of per diem wages from the Department of Industrial Relations, Division of Labor Statistics & Research, PO Box 420603, San Francisco, CA 94142-0603, (415) 703-4780; or wage rates may be accessed on the internet

at Prevailing Wage Requirements. The Contractor is responsible to read, understand and comply with all the guidelines, including the fine print in the prevailing wage determinations; and shall post a copy of the prevailing wage rates, specific to the Project, at the Project site.

.2 Wage rates set forth are the minimum that may be paid by the Contractor. Nothing herein shall be construed as preventing the Contractor from paying more than the minimum rates set. No extra compensation will be allowed by the State due to the inability of the Contractor to hire labor at minimum rates, nor for necessity for payment by the Contractor of subsistence, travel time, overtime, or other added compensations, all of which possibilities are elements to be considered and ascertained to the Contractor's own satisfaction in preparing the Bid Form

.3 If it becomes necessary to employ crafts other than those listed in the General Prevailing Wage Rate booklet, the Contractor shall contact the Division of Labor Statistics and Research as noted above. The rates thus determined shall be applicable as minimum for the contract and incorporated in the bid. When the wage determination shows an expiration date (noted by a double asterisk**), to expire during the term of the contract, the Contractor must call or write the DIR to obtain the new rates and incorporate them in the bid to be applicable for the term of the contract.

.4 The Contractor and each subcontractor, regardless of tier, shall keep an accurate payroll record showing the names, addresses, social security numbers, work classifications, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and/or subcontractor in connection with the Work. Payroll records shall be certified and shall be on forms provided by the Division of Labor Standards Enforcement, or shall contain the same information as those forms. The Contractor's and subcontractor's certified payroll records for each employee shall be submitted with each payment request, covering the period of the payment request unless requested otherwise by the Labor Commissioner of the Department of Industrial Relations pursuant to Labor Code Section 1771.4(c)(2)(b) monthly payrolls should be sent directly to the Department of Industrial Relations in the current prescribed electronic format. Refer to Certified Payroll Reporting for access to the electronic Certified Payroll (eCRP) Application.

.5 Labor Compliance Monitoring and Enforcement: This project is subject to monitoring and enforcement by the Department of Industrial Relations (DIR), Compliance Monitoring Unit. All Contractors and subcontractors, regardless of tier, shall be required to comply with the Monitoring and Enforcement Program, including, but not limited to, contractor registration, submittal of electronic certified payroll reports directly to the DIR and cooperation with on-site monitoring by DIR personnel.

Paragraph 3.13, TESTS AND INSPECTIONS

Delete Subparagraph 3.13.1 in its entirety and replace with the following Subparagraph 3.13.1.

3.13.1 The Contractor shall at all times permit the State, its agents, officers, and employees to visit the Project site and inspect the Work, including shops where the work is in preparation. This obligation shall include maintaining proper facilities and safe access for such inspection. Including, but not limited to providing lifts, ladders, scaffolds, platforms and paths of travel. When the Contract Documents require a portion of the Work to be tested, such portion of the work shall not be covered up until inspected and approved by the State. The Contractor shall be solely responsible for notifying the State where and when the work is ready for inspection and testing and shall give written notice no fewer than two business days prior to the time of inspection. For inspections that require the State Fire Marshal's (SFM) presence, the Contractor shall provide the State's Inspector of Record (IOR) written notice where and when the work is ready for inspection no fewer than three business days prior to the time of inspection.

Should any work be covered without the required testing and approval, such work shall be uncovered and recovered at the Contractor's expense.

Delete Subparagraph 3.13.2 in its entirety and replace with the following Subparagraph 3.13.2.

3.13.2 If the State determines that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, the State will instruct the Contractor, in writing, to make arrangements for additional testing, inspection or approval by an entity acceptable to the State, and the Contractor shall give written notice to the State of where and when tests and inspections will be conducted no fewer than two business days prior to the time of the additional testing, inspection or approval so that the State may observe the procedures. For inspections that require the State Fire Marshal's (SFM) presence, the State's Inspector of Record (IOR) will make the necessary arrangements with the SFM. The Contractor shall provide ~~a~~ written notice no fewer than three business days prior to the time of inspection.

The State will bear the costs except as provided in Subparagraph 3.13.3.

Paragraph 3.25, CONTRACTOR REQUIRED NOTIFICATION OF CHANGES

Delete Paragraph 3.25 in its entirety and replace with the following Paragraph 3.25

3.25 CONTRACTOR REQUIRED NOTIFICATION OF CHANGES: The Contractor shall notify the State's Representative in writing of any change to Contractor's name, status, or information including but not limited to:

1. Name
   a. An amendment is required to change the Contractor's name as listed on this Agreement. Upon receipt of Contractor's notification and legal documentation of the name change, the State will process the amendment. Payment of invoices presented with a new name cannot be paid prior to approval of said amendment.
   b. The State shall not be liable for penalties or interest on payments which are delayed due to Contractor's change of name and subsequent amendment processing.
2. Address/Location
3. Federal Employer Identification Number (FEIN)
4. Type of Organization or Legal Status – including:
   a. Corporate
   b. Partnership
   c. Individual/Sole-Ownership
   d. Joint Venture
   e. Limited Liability Company
   f. DBA
5. Ownership
6. Officers or Key Personnel
7. License
8. Other (Bankruptcy, Etc.)

Contractor shall immediately provide an updated Standard Form 204 (IRS/FTB form) to the Architectural, Construction and Engineering Contracts Section within five (5) calendar days of any such relevant change.

The State shall not be liable for penalties or interest on payments which are delayed due to Contractor's lack of proper or timely notice and documentation of a relevant change in status which impacts the State's ability to pay.

Contractor shall submit the firm's status change in writing including the Contract Number, Project Title and all necessary backup and legal documentation to support the status change to:

The State Department of General Services, Administration Division
Office of Business and Acquisition Services, Contracts Services Section
707 Third Street, Suite 2-300
West Sacramento, CA 95605-2811

Paragraph 3.4, NONDISCRIMINATION CLAUSE

Delete Paragraph 3.4 in its entirety and replace with the following:

3.4.1. During the performance of this contract, the recipient, contractor, and its subcontractors shall not deny the contract's benefits to any person on the basis of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status, nor shall they discriminate unlawfully against any employee or applicant for employment because of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status. Contractor shall insure that the evaluation and treatment of employees and applicants for employment are free of such discrimination.

3.4.2. Contractor shall comply with the provisions of the Fair Employment and Housing Act (Gov. Code, § 12900 et seq.), the regulations promulgated thereunder (Cal. Code Regs., tit. 2, § 11000 et seq.), the provisions of Article 9.5, Chapter 1, Part 1, Division 3, Title 2 of the Government Code (Gov. Code, §§ 11135-11139.5), and the regulations or standards adopted by the awarding state agency to implement such article.

3.4.3. Contractor or recipient shall permit access by representatives of the Department of Fair Employment and Housing (DEFH) and the awarding state agency upon reasonable notice at any time during the normal business hours, but in no case less than 24 hours' notice, to such of its books, records, accounts, and all other sources of information and its facilities as said Department or Agency shall require to ascertain compliance with this clause.

3.4.4. Recipient, contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.

3.4.5. The contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.

3.4.6 STANDARD CALIFORNIA NONDISCRIMINATION CONSTRUCTION CONTRACT SPECIFICATIONS (GOV. CODE SECTION 12990)

These specifications are applicable to all state contractors and subcontractors having a construction contract or subcontract of $5,000 or more.

.1 As used in the specifications:

a. “Act” means the Fair Employment and Housing Act.

b. “Administrator” means Administrator, Office of Compliance Programs, California Department of Fair Employment and Housing, or any person to whom the Administrator delegates authority;

.2 Whenever the contractor or any subcontractor subcontracts a portion of the work, it shall include in each subcontract of $5,000 or more the nondiscrimination clause in this contract directly or through incorporation by reference. Any subcontract for work involving a construction trade shall also include the Standard California Construction Contract Specifications, either directly or through incorporation by reference.

.3 The contractor shall implement the specific nondiscrimination standards provided in paragraphs 6(a) through (e) of these specifications.

.4 Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer members of any group protected by the Act shall excuse the contractor's obligations under these specifications, Government Code section 12990, or the regulations promulgated pursuant thereto .5. In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.

.5 In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.

.6 The contractor shall take specific actions to implement its nondiscrimination program. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor must be able to demonstrate fully its efforts under steps a. through e. below:

a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and at all facilities at which the contractor's employees are assigned to work. The contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the contractor's obligations to maintain such a working environment.

b. Provide written notification within (7) seven days to the director of the DFEH when the referral process of the union or unions with which the contractor has a collective bargaining agreement has impeded the contractor's efforts to meet its obligations.

c. Disseminate the contractor's equal employment opportunity policy by providing notice of the policy to unions and training, recruitment and outreach programs and requesting their cooperation in assisting the contractor to meet its obligations; and by posting the company policy on bulletin boards accessible to all employees at each location where construction work is performed.

d. Ensure all personnel making management and employment decisions regarding hiring, assignment, layoff, termination, conditions of work, training, rates of pay or other employment decisions, including all supervisory personnel, superintendents, general foremen, on-site foremen, etc., are aware of the contractor's equal employment opportunity policy and obligations, and discharge their responsibilities accordingly.

e. Ensure that seniority practices, job classifications, work assignments, and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the equal employment opportunity policy and the contractor's obligations under these specifications are being carried out.

.7 Contractors are encouraged to participate in voluntary associations that assist in fulfilling their equal employment opportunity obligations. The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on equal employment opportunity in the industry, ensures that the concrete benefits of the program are reflected in the contractor's workforce participation, and can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's.

.8 The contractor is required to provide equal employment opportunity for all persons. Consequently, the contractor may be in violation of the Fair Employment and Housing Act (Government Code section 12990 et seq.) if a particular group is employed in a substantially disparate manner.

.9 The contractor shall not use the nondiscrimination standards to discriminate against any person because race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status.

.10 The contractor shall not enter into any subcontract with any person or firm decertified from state contracts pursuant to Government Code section 12990.

.11 The contractor shall carry out such sanctions and penalties for violation of these specifications and the nondiscrimination clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Government Code section 12990 and its implementing regulations by the awarding agency. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Government Code section 12990.

.12 The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company equal employment opportunity policy is being carried out, to submit reports relating to the provisions hereof as may be required by OCP and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, status, (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in any easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

3. ARTICLE 4 – SUBCONTRACTORS

Paragraph 4.2, SUBCONTRACTUAL RELATIONS

Delete Paragraph 4.2.2 and replace it with the following Paragraph 4.2.2:

4.2.2 Subcontractor Payments: Subcontractors and Sub-subcontractors shall be paid for work performed in accordance with Public Contract Code Sections 10262 and 10262.5.

Delete Paragraph 4.3 and replace it with the following Paragraph 4.3

4.3 DISABLED VETERAN BUSINESS ENTERPRISE PROGRAM: Pursuant to Public Contract Code (PCC) Section 10115 et. seq., the Contractor shall use, employ and utilize Disabled Veteran Business Enterprise (DVBE) subcontractors, sub-subcontractors or material suppliers who were listed in their bid documents for DVBE Program participation, to the full extent of the amount of money and/or percentage of commitment manifested in the bid documents. If the Contractor wishes to substitute any listed DVBE subcontractors, sub-subcontractors or material suppliers for just and legal cause, the Contractor shall follow the dictates of PCC Sections 4107 and 10115.12b, as well as Military and Veterans Code (M&VC) Section 999.5(e) and California Code of Regulations, Title 2, Section 1896.64. The DVBE may only be replaced by another DVBE and shall obtain the written authorization of the State prior to any such substitutions. The Contractor shall not unilaterally substitute a listed DVBE subcontractor, sub-subcontractor or material supplier. Failure of Contractor to seek substitution and adhere to the DVBE participation requirement identified in the bid may be cause for contract termination, recovery of damages under rights and remedies due to the State, and penalties as outlined in M&VC Section 999.9; PCC Sections 4110 and PCC Section 10115.10.

4. ARTICLE 7 – TIME

Paragraph 7.2, CONTRACT TIME

Delete Subparagraph 7.2.1 and replace it with the following Subparagraph 7.2.1:

7.2.1 Time is of the Essence in this Contract. The Contractor shall complete all the Work of the Contract within the Contract Time of:

THREE HUNDRED AND SIXTY-FIVE DAYS (365)

calendar days, starting on the Start Date stipulated in the Notice to Proceed, which the Contractor will receive not less than 5 days in advance.

Paragraph 7.3, LIQUIDATED DAMAGES

Add the following Subparagraphs 7.3.1 and 7.3.2:

7.3.1 The Contractor shall pay to the State the sum of $2,000 per day for each and every calendar day delay in finishing of Work under this Contract beyond the Contract time.

7.3.2 If the Contractor is more than 14 calendar days behind schedule at any point during the Contract Time, based on the latest updated Official Progress Schedule, the State will withhold $2,000 per day for each and every day that the Contractor is behind schedule from the monthly payment for that month. If the Contractor recoups all or a portion of the delay during the next pay period, the amount withheld will be reduced accordingly.

5. ARTICLE 8 – PAYMENTS AND COMPLETION

Paragraph 8.2, TIMELINESS OF PAYMENTS

Delete Paragraph 8.2.3 and replace it with following Paragraph 8.2.3:

8.2.3 The State will make progress payments pursuant to Public Contract Code, Sections 10261 and 10261.5.

Paragraph 8.3, RETENTIONS

Delete Subparagraph 8.3.1.2 and replace it with the following Subparagraph 8.3.1.2:

.2 The State shall retain 5 percent of the estimated value of Work completed.

Paragraph 8.5, OCCUPANCY BY THE STATE PRIOR TO COMPLETION OF THE WORK

Delete Paragraph 8.5.1 and replace it with the following:

8.5.1 The State reserves the right to occupy all or any part of the Project prior to Completion of the Work, upon written notice. Such occupancy or use is herein referred to as Beneficial Occupancy. In this event, the Contractor shall be relieved of responsibility to the State for liability arising out of such occupancy by the State.

6. ARTICLE 11 – INSURANCE AND BONDS

Paragraph 11.1, CONTRACTOR'S INSURANCE

Delete Paragraph 11.1 and replace it with the following 11.1:

11.1 CONTRACTOR'S INSURANCE

11.1.1 General Insurance Requirements:

.1 Contractor shall procure and maintain insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder and the results of that work by the Contractor, its agents, representatives, employees or subcontractors.

.1 Contractor shall furnish the State with certificates and endorsements effecting coverage required by this clause. All certificates and endorsements are to be received and approved by the State before work commences.

.2 The State reserves the right to require complete, certified copies of all required insurance policies, including endorsements affecting the coverage required by these specifications at any time.

.2 Insurance Companies shall be acceptable to Department of General Services (DGS) and Office of Risk and Insurance Management (ORIM). Insurance is to be placed with insurers with a current A.M. Best's rating of no less than A-VII, unless otherwise acceptable to DGS, Office of Risk and Insurance Management. Exception may be made for the State Compensation Insurance Fund. If self-insured, review of financial information may be required.

.3 Except as otherwise provided for Builders Risk/Installation Floater under Clause 11.1.2.4, all coverage shall be in force until the Acceptance of the Work by the Director of DGS. If the insurance expires, the Contractor shall immediately provide a new current certificate or be declared in breach of Contract. The State reserves the right to withhold all progress and retention payments until the breach is cured to the satisfaction of the State. Renewal insurance certificates must be tendered to the State prior to or exactly at the expiration of the previous insurance certificate. There shall be no gap in insurance coverage. This renewed insurance shall be in accordance with the terms of the Contract.

.4 Contractor is responsible to notify the State a minimum of five (5) business days before the effective date of any cancellation, non-renewal or material change that affects required insurance coverage.

.5 Unless otherwise stated in the contract, the Contractor shall be responsible for any premium deductible or self-insured retention contained within the insurance.

.6 All insurance policies required by this contract must allow the State to pay and/or act as the contractor's agent in satisfying any self-insured retention (SIR). The choice to pay and/or act as the contractor's agent in satisfying any SIR is at the State's discretion.

.7 In the event the Contractor fails to keep in effect at all times the specified insurance coverage, the State may, in addition to the remedies noted in Article 11.1.1.3 above and any other remedies it may have, remove the Contractor from the work site and/or may terminate this Contract upon the occurrence of such event, subject to the provisions of this Contract.

In the event, the State elects to remove the Contractor from the work site, the Contractor will not be entitled to additional days or compensation.

.8 Any insurance required to be carried shall be primary and not excess or contributory, to any other insurance carried by the State.

.9 Any required endorsement requested by the State must be submitted with all requested certificates of insurance and not substituted by referring to such coverage on the certificate of insurance.

.10 Minimum Scope of Insurance - Coverage shall be at least as broad as:

.1 Insurance Services Office Commercial General Liability coverage (occurrence Form CG 0001). .2 Insurance Services Office Form Number CA 0001 covering Automobile Liability, "any auto", or "all owned, hired and non-owned".

.11 All coverage and limits available to the contractor shall also be available and applicable to the State.

.12 Contractor shall procure and maintain insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees, or subcontractors.

.13 With the exception of Builders Risk/Installation Floater, Contractor shall require and verify that all subcontractors maintain insurance coverage and limits meeting or exceeding all the requirements stated herein. Contractor shall ensure that the Department of General Services and the State of California, its officers, agents, and employees, as additional insured on insurance required from subcontractors but only insofar as the operations under the Contract are concerned. For Commercial General Liability coverage subcontractors shall provide coverage with a form at least as broad as CG 20 38 04 13. The State reserves the right to require the Contractor to provide the subcontractors' insurance certificates and policies, when so directed by the State.

11.1.2 Insurance Requirements: The Contractor shall furnish to the State evidence of the required insurance as follows:

.1 Commercial General Liability: The Contractor shall maintain commercial general liability with limits of not less than $5,000,000 per occurrence for bodily injury and property damage liability combined. If Commercial General Liability insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit shall be twice the required occurrence limit. If the aggregate applies "per project or location", it shall so state on the certificate. The policy shall include coverage for liabilities arising out of premises, operations, independent contractors, products, completed operations, personal and advertising injury, and liability assumed under an insured contract. This insurance shall apply separately to each insured against whom claim is made or suit is brought subject to the Contractor's limit of liability. The policy shall include the Department of General Services and the State of California, its officers, agents, and employees, as additional insureds, but only insofar as the operations under the Contract are concerned.

  .1 Additional Insured coverage shall be provided in the form of an insured endorsement as broad as the (CG 20 10 11 85) to the contractor's insurance policy. All coverage and limits available to the named insured shall be available and applicable to the additional insured. The endorsement must be attached to the certificate.

  .2 Deductibles and Self-Insured Retentions (for Commercial General Liability): Any deductibles or self-insured retentions must be declared to and approved by the State. At the option of the State, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the State of California and the Department of General Services, its officers, agents, employees and servants or the Contractor shall provide a financial guarantee satisfactory to the State guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

.2 Automobile Liability: The Contractor shall maintain motor vehicle liability with limits of not less than $1,000,000 per accident for bodily injury and property damage. The State is to be covered as additional insured with respect to liability arising out of automobiles owned, leased, hired or borrowed by or on behalf of the contractor. The policy shall include the Department of General Services and The State of California, its officers, agents, and employees, as additional insureds, but only insofar as the operations under the Contract are concerned. All coverage and limits available to the named insured shall also be available and applicable to the additional insured.

.3 Workers' Compensation: The Contractor shall maintain statutory workers' compensation and employer's liability coverage for all its employees who will be engaged in the performance of the Contract, including special coverage extensions where applicable as required by the State of California. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the State for all work performed by the contractor,

its employees, agents and subcontractors. Except for State Fund certificates, all subrogation waiver endorsements shall be submitted on a separate form. The Contractor shall maintain Employer's Liability coverage of $1,000,000 per accident for bodily injury or disease.

.4 Builders Risk/Installation Floater: The State shall insure all Work while in the course of construction, reconstruction, remodeling or alteration, including materials incorporated in the Work, against physical loss or damage resulting from the perils normally insured under an All Risk Builders Risk/Installation Floater policy, including, but not limited to theft, fire and vandalism. The State will self-insure against Acts of God and natural disasters proclaimed by the State or Federal Government. The State will issue to the Contractor a "Summary of Coverage" provided under this Clause 11.1.2.4 Summary of Coverage and Certificate of Insurance will be provided to contractor as part of the executed contract.

.1 Contractor shall be responsible for paying a deductible not to exceed $10,000 for water damage and $5,000 for all other perils per occurrence in the event of loss.

.2 The proceeds under the Builder's Risk/Installation Floater Insurance procured by the State will be payable to the State and Contractor as their respective interests, from time to time, may appear.

.3 State's Builders Risk/Installation Floater Insurance shall provide limited coverage for materials in transit and materials stored off-site, and full coverage for materials at the Project site; however, the Contractor is responsible for reviewing the "Summary of Coverage" and reporting values that exceed the limits provided within the Summary of Coverage. Notification to the State does not provide coverage. Value increases must be approved by the insurance carrier and contractor must have a Certificate of Insurance issued by the insurance carrier showing the increased values. Lacking confirmation from the State's insurance carrier that additional coverage was procured, Contractor will be responsible for damages in excess of the coverage limits provided within the Summary of Coverage.

.4 Nothing in this Clause 11.1.2.4 shall be construed to relieve the Contractor of Contractor's responsibilities referred to under Clause 11.1.1 and Clause 11.1.2.

.5 Insurance policies referred to in this Clause 11.1.2.4 shall provide the following:

.1 That the policies are primary and do not participate with nor are excess over any other valid collectible insurance carried by the Contractor.

.2 That the Insurer waives the right of subrogation against the Contractor.

END OF DOCUMENT

SECTION 01 11 00

SUMMARY

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work required to be performed by the Contractor comprises:

CALIFORNIA AFRICAN AMERICAN MUSEUM (CAAM) CONFERENCE CENTER, STORAGE AND LIBRARY IMPROVEMENTS, RE-ROOF AND HVAC UPGRADES

LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA

in conformity with the Drawings and Specifications hereinafter identified; including furnishing all material, labor, plant, tools, equipment, and services necessary therefor and incidental thereto, complete and ready for use, except as hereinafter otherwise provided.

1.02 WORK NOT INCLUDED

A. Except for such auxiliary work as is shown or specified or is necessary as a part of the construction, the following work is NOT included in this Contract.

1. Work shown, but marked "NIC" (Not in Contract). "BUA" (By Using Agency), or otherwise designated to be done by others.

1.03 LOCATION OF SITE

A. The site of the work is on State of California property located at:
600 State Drive, Los Angeles, CA 90037

1.04 SPECIFICATIONS

A. The Specifications are those bound in the Project Manual and enumerated in the Table of Contents. The General Conditions of the Contract for Construction, Supplementary Conditions, and Division 01 of the Specifications apply to all Work of this Contract.

1.05 DRAWINGS

A. The Drawings consist of Drawing Sheets as listed in Document 00 01 15 of Project Manual.

1.06 CONTRACTOR'S SETS OF DRAWINGS AND PROJECT MANUALS

A. State Furnished Drawings and Project Manuals: Upon award of Contract, the State will provide Drawings and Project Manuals upon Contractor request as follows:

1. Electronic Files
2. Drawings: 5 sets
3. Project Manuals: 5 sets.

B. Additional Sets shall be the responsibility of the contractor.

1.07 SECURITY REGULATIONS

A. Contractor shall cooperate with the authorities and shall observe and comply with all regulations presently in force on grounds. Refer to Section 01 31 00, Project Management and Coordination.

B. After award of Contract, there will be a project start meeting, at which time security regulations will be reviewed with Contractor and subcontractor.

1.08 INTERRUPTION OF SERVICES

A. Contractor shall make provisions to accomplish the work of this Contract without undue interference with operations. Interruptions to services for the purpose of making or breaking connection shall be made only after consultation with the State a minimum of one week in advance of connection break, and shall be at such time and of such duration as may be directed.

B. In addition, existing electrical, mechanical and security lines disconnected for work of this Contract shall not remain disconnected for more than 1 hour. If electrical power cannot be restored within the 2 hour period, Contractor shall provide temporary electrical service to restore required electrical power at Contractor's expense.

1.09 SEQUENCE OF CONSTRUCTION OPERATIONS

A. Before starting construction operations, Contractor shall confer with the State to review sequence of construction operations.

B. Contractor shall prepare schedules as set forth in Section 01 32 16, Progress Schedules and Reports.

C. Contractor shall coordinate erection of wall framing, wall panels, partitions or other space enclosure with requirements of others for moving large pieces of equipment into building or into room to be enclosed. Contractor shall consult with others as to the necessity for deferring erection of such enclosures and shall deliver to the State a schedule of such deferments and reasons therefor. Cost of deferring construction shall be borne by Contractor.

1.10 HOURS OF WORK

A. Contractor shall perform Work of this Contract on normal work days and within normal work hours; 7:00 am to 4:00 pm. After hours work and work on Saturdays, Sundays, and holidays, may be permitted if approval is received from the State at least 3 working days in advance.

1.11 SITE CONDITIONS AND REQUIREMENTS

A. Contractor shall keep drainage facilities, walks, and paved areas clean and free of mud and dirt, obstacles, etc. so that normal drainage and pedestrian and vehicular travel may be maintained.

B. Do not use landscaped area(s) for work operations or storage.

1.12 EXCAVATIONS OR TRENCHING FOR UNDERGROUND UTILITIES

A. Time intervals between excavation or trenching and installation of conduit or piping or other work concerned, and backfilling operations shall be kept to absolute minimum.

B. Excavations or trenching crossing roadways, walks, or other trafficways shall be provided with traffic bearing steel plate or wood planking temporary covers; as most suitable.

C. Contractor shall conduct operations on the basis that underground installations exist which are not indicated on the Contract Drawings. Refer to the following Article 1.14 for additional requirements.

1.13 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Refer to the General Conditions of the Contract for Construction for Contractor responsibilities.

B. Damage to existing improvements caused by Contractor's operations shall be repaired to restore damaged items to their original condition. Cost of such repair shall be borne entirely by Contractor.

C. Drawings indicate existing structures, drainage lines, water, gas, electrical and other similar items and utilities which are known to the State.

D. Locate known existing structures and utilities before proceeding with operations which may damage same. Maintain them in service, except as otherwise specified, provide protection and repair damage to them caused by the Work at no increase in Contract price.

E. Additional utilities whose locations are unknown to the State may exist. Contractor shall be alert to their existence. If encountered, immediately report to the State for disposition of same.

1.14 HAZARDOUS MATERIALS DISCOVERED AND DISTURBED IN THE COURSE OF PERFORMING CONTRACT WORK

A. In the event that existing construction materials are identified as containing asbestos materials and/or are disturbed in the course of performing work under this Contract, Contractor shall cease work around the suspect area immediately and notify the State Inspector and/or Project Director. Site conditions and extent of asbestos related work will be assessed by the State, to determine required changes in the work. Affected work activities under this Contract shall not resume until such determination is made by the State.

1.15 HOLES CUT IN STEEL DECKING

A. Holes cut in steel decking at the site shall be reinforced in the manner shown on the Structural Drawings for the hole size required, or as required by the State.

1.16 PARK RULES AND REGULATIONS

A. Persons entering Park premises, including Contractor, subcontractors, and their employees, are subject to “Rules and Regulations for the State Park System” as set forth in California Code of Regulations, Chapter 5, Title 14. Persons who fail to comply with these “Rules and Regulations” may be barred from further work at the Park.

B. Permission will be granted to Contractor, subcontractors, and their employees and vehicles to enter the Park free of charge.

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 PROJECT CONTROL

A. The State's Representative will outline and detail communication, correspondence and coordination procedures at Project start meeting.

B. Examination of Site: Contractor and subcontractors shall visit the site prior to bidding and prosecution of the Work and shall familiarize themselves with existing conditions and be prepared to carry out the Work within existing limitations.

C. Condition of Work in Place: Inspect and take responsibility for previously prepared or installed work of other contractors before applying subsequent materials or finishes. If work is in unsatisfactory condition, notify the State. Do not proceed until defective work has been corrected.

D. Coordination:

1. Subletting and Subcontracting Responsibilities: Refer to General Conditions of the Contract for Construction, Article 4.

2. Contractor shall coordinate the Work with related work being done by the State and other contractors operating in the area. This coordination shall include reasonable adjustments of schedule in order to allow other contractors or State to do their work.

3. Contractor shall coordinate electrical/mechanical work, particularly between general trades and mechanical/electrical trades so that sleeves, hangers, chases, openings, etc., required for pipe, conduit, and other installations of like character are duly and properly provided for and installed as work progresses.

4. Contractor shall carefully examine Drawings relating to entire work with actual conditions so that Work will be accommodated in spaces provided. General arrangement and location of elements of various systems is shown on the Drawings or specified. Final locations, levels, etc., shall be governed by actual material size used, by building conditions encountered, and by work of all trades. Space conflicts and interferences shall be resolved before work is installed.

5. Contractor shall utilize the Contract Documents, submittals, and layout drawings of the various trades to check and coordinate the Work so that no interferences or conflicts between trades will occur. This checking and coordination shall be performed and completed before construction is commenced in each affected area.

6. Coordinate work to assure efficient and orderly sequence of installation of construction elements. Make provisions for accommodating items installed by the State or under separate contracts.

7. Verify characteristics of interrelated operating equipment are compatible; coordinate work having interdependent responsibilities for installing, connection to, and placing such equipment in service.

1.02 LOCATIONS, ELEVATIONS, AND LAYOUT OF WORK

A. Property lines, location ties, and elevations of components of the Project to be built under this Contract are shown on the Drawings. Grade elevations shown for various parts of the Work are taken from a bench mark shown on the Drawings, or if not shown, will be designated by the State. In case of conflict therein, notify the State in writing before starting work.

B. Contractor shall lay out the Work and furnish surveys required for alignment and elevations of the Work, and shall pay all costs therefor. Contractor shall furnish necessary lines, levels, locations, measurements and markers for all on the Work and be responsible for their accuracy.

C. On building structures, Contractor shall lay out on forms, walls, floors, and columns, the exact location of partitions as guide to all trades.

1.03 SCHEDULES AND MEETINGS

A. Planning and Scheduling: Refer to Section 01 32 16.

B. Project and Preinstallation Meetings: Contractor or his duly appointed representative shall attend project meetings at regular intervals as set by the State and shall attend preinstallation meetings as required by pertinent Specification Sections. Attendance shall be limited to the Contractor and his immediate subordinates, subcontractors where so specified, the State, and representatives of the Architect and Consultants, as requested. State, or State's duly appointed representative, will keep minutes of meetings; with copies sent to all who attend. Meetings shall be held at job site at 600 State Drive, Los Angeles, Los Angeles Count.

C. Project Construction Phases: Work of this Contract shall be executed in one phase.

1.04 ALLOWABLE ENTRANCE

A. Contractor, subcontractors, their employees, suppliers and delivery persons shall enter and exit property via designated entrance.

END OF SECTION

SECTION 01 32 16

PROGRESS SCHEDULES AND REPORTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work under this Section shall consist of furnishing computerized Time Scaled Critical Path Method (CPM) Progress Schedule showing in detail how Contractor plans to execute and coordinate the Work; and submitting schedules, logs, updates and reports.

1.02 RELATED REQUIREMENTS

A. Document 00 72 00 - General Conditions of the Contract for Construction; Paragraph 3.10 and Article 7.

B. Document 00 73 00: Supplementary Conditions; Contract time and liquidated damages.

C. Section 01 31 00: Project Management and Coordination.

D. Section 01 33 00: Submittal Procedures.

1.03 SCHEDULE DESCRIPTION

A. Schedule shall be based on and incorporate Contract Milestone and Completion Dates specified in the Contract Documents. Schedule shall furnish or comply with the following requirements:

1. Time scaled CPM type schedule.

2. No activity on schedule shall have duration longer than 21 calendar days, with exception of fabrication and procurement activities, unless otherwise approved by the State. Activity durations shall be total number of actual days required to perform that activity including consideration of weather impact on completion of that activity. The schedule shall include all construction activities and related activities, on and off site. All activities shall have “Earliest Start Date” and “Latest Start Date” and “Earliest Finish Date” and “Latest Finish Date”. Specific activities shall be included, as indicated in this Section, and shall also include, but not be limited to Mobilization, Construction of Temporary Facilities and Start-Up and Testing Activities.

3. Procurement of major equipment, through receipt and inspection at job site, identified as separate activity.

4. State-furnished materials and equipment, if any, shall be identified as separate activities.

5. Dependencies (or relationships) between activities.

6. Processing/approval of submittals and shop drawings for major equipment. Activities dependent on submittal acceptance and/or material delivery shall not be scheduled to start earlier than expected acceptance or delivery dates.

8. Responsibility code for each activity corresponding to subcontractor responsibility for performing the Work.

9. Allow 30 calendar days for developing punch list(s), completion of punch list items, and final inspection of Work, or designated portion thereof, by the State. No other activities shall be scheduled during this period.

10. Interface with work of other contractors (or entities).

11. Separate buildings and other independent project elements shall be individually identified in network.

B. Overall time of completion and time of completion for each milestone shown on the Schedule shall adhere to the specified Contract time, unless an earlier (advanced) time of completion is requested by Contractor, agreed to by the State, and formalized by Change Order.

C. Schedule shall be the basis for evaluating job progress, progress payments, and time extension requests. Contractor shall develop Schedule and monitor actual progress as compared to Schedule.

D. Contractor shall use Microsoft Project 2010, Primavera Suretrak, Primavera P6 Professional Project Management software, or equal.

If Contractor chooses to use an equal to specified software, submit software data for approval and provide the State with licensed copy of latest revision of approved software registered to the State.

1.04 SUBMITTALS

A. Schedule for First 90 Days: Within 10 calendar days after the Start Date stated in the Notice to Proceed, and prior to proceeding with any work on site, submit diskettes and 3 prints of detailed Schedule presenting orderly and realistic plan for completion of the Work for the first 90 days, in conformance with requirements of this Section.

1. Provide MS-Windows files by flash drives containing Schedule files.

2. The State will review submitted Schedule for conformance with requirements. Within 7 calendar days after receipt, the State will accept Schedule or will return it with comments. If proposed Schedule is not accepted, Contractor shall revise Schedule to incorporate comments and resubmit Schedule for acceptance within 7 calendar days after receiving it.

3. Acceptance of Schedule by State, failure of Schedule to include an element of work, or inaccuracy in Schedule will not relieve Contractor from responsibility for accomplishing Work in accordance with the Contract.

B. Procurement Log: Submit 4 copies of a Procurement log, cross-referenced to Schedule, including the following information for each type of material or equipment to be provided:

1. Material or equipment description.

2. Technical specification reference.

3. Duration in calendar days required for preparation and review of submittals.

4. Duration in calendar days required for fabrication and delivery.

5. Cross reference to activities which will be affected by delivery date of material or equipment item.

6. Scheduled delivery dates.

C. Official Progress Schedule: Within 30 calendar days after the Start Date stated in the Notice to Proceed and prior to the first progress payment, submit diskettes and 3 prints of detailed Schedule presenting orderly and realistic plan from the start date to completion of the Work in conformance with requirements of this Section.

1. Provide MS-Windows files by flash drives containing Schedule files.

2. The State will review submitted Schedule for conformance with requirements. Within 14 calendar days after receipt, the State will accept Schedule or will return it with comments. If proposed Schedule is not accepted, Contractor shall revise Schedule to incorporate comments and resubmit Schedule for acceptance within 7 calendar days after receiving it. Accepted Schedule shall become the Official Progress Schedule.

3. Acceptance of Schedule by State, failure of Schedule to include an element of work, or inaccuracy in Schedule will not relieve Contractor from responsibility for accomplishing Work in accordance with the Contract.

D. Updates, Reports, and Revisions: Submit flash drives and 3 copies of updates, reports, and revisions, as required under Articles 1.05, 1.06, and 1.07 of this Section.

1.05 SCHEDULE UPDATES

A. Contractor shall submit to State an up-to-date status report of the Work, at uniform intervals, once each month, prior to progress payment. Status report shall include:

1. Contractor's estimated percentage complete for each activity not yet complete.

2. Actual start/finish dates for activities as appropriate.

3. Identification of processing errors, if any, on previous update reports.

4. Revisions, if any, to assumed activity durations including revisions for weather impact for activities due to effect of previous update on schedule.

5. Identification of activities which are affected by proposed Change Orders issued during update period. (See Network Window, Article 1.06 B).

6. Resolution of conflict between actual work progress and schedule logic. When out of sequence activities develop in Schedule because of actual construction progress, Contractor shall submit revision to schedule logic to conform to current status and direction.

B. The State will review updated information and meet with Contractor each month to determine status of the Work. If agreement cannot be reached on any issue, the State’s determination will be used in processing of update by Contractor.

C. Contractor shall incorporate the State’s review comments and submit reports and number of copies as required under Article 1.04 of this Section.

D. Progress payments pursuant to Contract will be based on the update of the Schedule.

E. Partial payment for "mobilization" shall be made in percentages as follows (less retainage):

Contract Amount Completed	Payment for Mobilization
5 %	50% of amount bid for mobilization, or 5% of original Contract amount, whichever is lesser.
10%	75% of amount bid for mobilization, or 7.5% of original Contract amount, whichever is lesser.
20%	95% of amount bid for mobilization, or 9.5% of original Contract amount, whichever is lesser.
50%	100% of amount bid for mobilization, or 10% of original Contract amount, whichever is lesser.

Upon completion of all Work on the Project, payment of any amount bid for mobilization in excess of 10% of the original Contract amount will be paid.

1.06 SCHEDULE REVISIONS

A. If sequence of construction differs significantly, as determined by the State, from Schedule, Contractor shall submit within 21 calendar days a revised Schedule to the State for review.

B. When proposed Change Order is issued which has potential to impact specified completion dates, a Network Window shall be prepared by Contractor to reflect impact of such changes. After Network Window has been accepted and Contractor ordered to proceed with proposed Change Order, it shall be incorporated into Schedule. No additional cost beyond that provided in the General Conditions will be allowed for incorporation of approved proposed Change Orders into Schedule.

C. Should Contractor, after acceptance of Schedule, intend to change their plan of construction, they shall submit their requested revisions to the State, along with written statement of revision, including description of logic for rescheduling the Work, methods of maintaining adherence to intermediate milestones and other specific dates and reasons for revisions. If requested changes are acceptable to the State, they will be incorporated into Schedule in next reporting period.

D. Schedule revisions shall be submitted at least 7 calendar days prior to date of submission of update information; number of copies as specified in Article 1.04 of this Section.

1.07 SCHEDULE REPORTS

A. Contractor shall submit the following reports for the Schedule, Schedule updates, Schedule revisions and recovery schedules:

1. Schedule Logic Report listing activities, their early/late and actual start and finish dates, duration, float and logic relationship of activities sorted by early start.

2. Bar chart showing status of activities.

3. Narrative report with updated progress analysis, which shall include description of problem areas, current and anticipated delaying factors and their impact, explanation of corrective action taken and proposed revisions for recovery. Narrative report on submitted Schedule shall outline Contractor’s overall plan, strategy, crew movement and utilization and other considerations in developing the Schedule.

4. Network Plots presenting time scaled network diagram showing activities and their relationships.

B. In addition to the above reports, the State may request, from month-to-month, any of the following reports:

1. Total float from least to most.

2. Activities by early start.

3. Activities by late start.

4. Activities grouped by subcontractors or selected trades.

5. Activities with scheduled early start dates in a given time frame (i.e. 30 or 60 day outlook).

C. Contractor shall submit flash drives and number of copies of Schedule reports as specified in Article 1.04 of this Section.

1.08 TIME EXTENSIONS

A. Contractor shall submit network window for claimed time extension requests, showing impact of claimed delay on Schedule.

B. Float or Slack Time is the amount of time between earliest start date and late start date or between earliest finish date and latest finish date of activities of Schedule. No time extensions or delay costs will be allowed for delays caused by the State, on paths or activities containing float time, providing such delay does not exceed float time in latest updated version of Schedule.

C. The State shall have no obligation to consider time extension request unless requirements of Contract Documents are complied with; the State shall not be responsible or liable to Contractor for constructive acceleration due to failure of the State to grant time extensions under the Contract Documents, should Contractor fail to comply with submission requirements and justification requirements of this Contract for time extension requests. Contractor's failure to perform in accordance with Schedule shall not be excused because Contractor has submitted time extension requests, until and unless such requests are approved by the State.

1.09 SHORT INTERVAL SCHEDULE

A. Short Interval Scheduling (SIS) shall be used throughout onsite construction activity.

B. Interval shall be a 3 week projection and shall include week submitted and two weeks thereafter.

C. It shall contain sufficient detail to evaluate daily milestones and manpower/equipment loading and shall identify/tie into monthly updated Schedule.

D. Short Interval Schedule shall be submitted weekly.

E. A weekly meeting will be scheduled by the State to review and discuss Short Interval Schedules.

1.10 RECOVERY SCHEDULE

A. If Schedule falls 14 calendar days behind schedule on milestone dates or completion dates, Contractor shall prepare and submit Recovery Schedule, form and detail appropriate to the need, to explain and display how Contractor intends to reschedule those activities to regain compliance with Schedule during immediate subsequent pay period.

B. Recovery schedule, upon acceptance by the State, shall be incorporated into Schedule by Contractor.

1.11 DAILY REPORTS

A. Contractor shall submit Daily Activity Report to the State for each workday, including weekends and holidays, when worked.

B. Contractor may use Contractor's own report form, provided it contains same information included in standard form furnished by the State.

1.12 PAYMENTS WITHHELD

A. Progress Payments may be withheld in whole or in part should Contractor fail to comply with requirements of this Section.

B. Refer to Document 00 72 00, General Conditions of the Contract for Construction.

END OF SECTION

SECTION 01 32 33

CONSTRUCTION PHOTOGRAPHS

PART I - GENERAL

1.01 SECTION INCLUDES

A. Photography.

B. Digital Files.

C. Prints.

D. Submittals.

1.02 RELATED SECTIONS

A. Document 00 72 00 - General Conditions of the Contract for Construction; Payment procedures.

B. Section 01 11 00: Summary.

C. Section 01 33 00: Submittal Procedures.

D. Section 01 35 16: Alteration Project Procedures.

E. Section 01 77 00 - Closeout Procedures: Project record documents.

1.03 PHOTOGRAPHY

A. Provide full-color digital photography of site and construction throughout progress of Work produced by commercial photographer or other experienced photographer acceptable to the State.

B. Provide non-aerial photographs from four cardinal views, minimum, at each specified event, for each building or construction activity area, until completion of Project. Provide additional oblique angles of view and/or close-ups as required to properly communicate stage of construction process being recorded.

C. Provide factual presentation. Prints and/or digital files shall not be manipulated in any manner except as to correct for exposure/contrast and/or sharpness shortcomings.

D. Provide images with optimal exposure, contrast, sharpness/resolution and maximum depth-of-field and minimum distortion.

E. Take photographs not more than three calendar days prior to each scheduled application for payment, and as required to record the following events:
   1. Site clearing.
   2. Grading/Building pads.
   3. Excavations/Backfilling.
   4. Underground utility/infrastructure connections.
   4. Foundations.
   5. Structural framing.
   6. Enclosure of buildings (all faces).

7. Interior progress (room-by-room; area-by-area for larger spaces).
8. Final completion.

F. Provide digital photos and digital video of existing conditions. Refer to Section 01 35 16 for additional requirements. Contractor shall pay particular attention to any historic elements.

1.04 DIGITAL FILES

A. Digital capture shall be utilized.

B. Digital files shall have date (month/day/year) and time imprinted/recorded by camera at time of exposure.

C. Submitted digital files shall be in JPEG or TIFF format.

D. Digital files shall be a minimum of 640x480 pixels.

1.05 PRINTS

A. Provide three full-color prints of each submitted image. See Article 1.06.

B. Paper: High contrast; smooth; glossy.

C. Size: 5 x 7 inch (125 x 175 mm) in archival clear sleeves (for three-ring binder).

D. Prints from digital files shall utilize long-life inks, (minimum 25 years).

E. Identify each print on front of sleeve. Identify name of Project, Project Number, Contract Number, particular building or construction activity area, compass orientation of view, date and time of view, name and address of photographer and photographer's sequentially numbered identification of image, (keyed to corresponding negatives/digital file names).

1.06 SUBMITTALS

A. Deliver two sets of prints and digital files to State within 10 calendar days after exposing photographs of each event with transmittal letter as specified under Section 01 33 00.

B. Maintain one set of digital files and prints, identical to those submitted to the State, at the Project site.

C. Deliver corresponding submitted prints to State in archival negative sleeves (for three-ring binder), along with each print group submittal. Catalog and index negatives in chronological sequence, cross-referenced to prints. Provide typed table of contents.

D. Deliver digital files to State on accordingly labeled CD-R or flash drive. Catalog and index files in chronological sequence.

E. All prints and digital files shall become the property of the State without restriction on their use.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. To ensure that specified products are furnished and installed in accordance with Drawings and Specifications, transmittal procedures have been established for submittals for review by the State.

B. Make all following submittals in strict accord with provisions of this Section and with requirements of the General Conditions of the Contract for Construction.

1. Progress Schedule and Reports; including the Schedule of Values.

2. Product Certification.

3. Shop Drawings.

4. Descriptive Data/Material Lists.

5. Samples.

6. Substitutions.

7. Construction Waste Estimate.

8. Certification of Recycled Content.

9. Photography

10. Alteration Project Procedures

1.02 RELATED REQUIREMENTS

A. Document 00 72 00: General Conditions of the Contract for Construction.

B. Section 01 32 16: Progress Schedules and Reports.

C. Section 01 60 00: Product Requirements.

D. Section 01 74 19: Construction Waste Management; submittal of Construction Waste Estimate.

E. Section 01 74 20: Recycled Content Certification.

F. Section 01 77 00: Closeout Procedures; Submittal of operating and maintenance manuals, record documents, guaranties/warranties, Construction Waste Management Report, State Agency Buy Recycled Campaign Procurement Summary, and other closeout documentation.

G. Test Reports: Pertinent Specification Sections.

H. Individual Submittals Required: Pertinent Specification Sections.

PART 2 - PRODUCTS

2.01 PROGRESS SCHEDULE

A. Prepare and submit Progress Schedule of operations as required by Section 01 32 16.

B. Relate Progress Schedule to entire Project. Indicate dates for submission of required submittals.

C. Submit Schedule of Values with Progress Schedule. Refer to General Conditions of the Contract for Construction, Paragraph 3.10, Contractor’s Progress Schedule, and to Section 01 32 16, Progress Schedules and Reports, for additional cost breakdown requirements.

2.02 PRODUCT CERTIFICATIONS

A. Where specifically indicated by pertinent Specification Sections, submit proper certification by recognized producer or association. Certifications shall attest to product's compliance with requirements of Contract Documents.

2.03 SHOP DRAWINGS

A. Submittals shall include digital, pdf of each submittal, including, name and location of project, name of Contractor, work order and contract numbers and cross references to contract documents. Number shop drawings consecutively. Make drawings legible and complete in every respect. Refer to General Conditions of the Contract for Construction, Paragraph 3.12.

B. If Shop Drawings show variations from Contract requirements because of standard shop practice or other reason, make specific mention of such variations in letter of transmittal, as well as on drawings, in order that (if acceptable) suitable action may be taken for proper adjustment of Contract. Unless specific changes have been noted and accepted, no deviations from Contract Documents will be permitted.

2.04 PRODUCT DATA/MATERIAL LISTS

A. Manufacturer's Standard Schematic Drawings:

1. Modify drawings to delete information which is not applicable to Project.

2. Supplement standard information to provide additional information applicable to Project.

B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:

1. Clearly mark each copy to identify pertinent materials, products or models.

2. Show dimensions and clearances required.

3. Show performance characteristics and capacities.

4. Show wiring diagrams and controls.

5. Include calculations when applicable.

C. Material Safety Data Sheets (MSDS): Include for materials which require manufacturer's warnings and application instructions listed on MSDS provided by the product manufacturer.

2.05 SAMPLES

A. Physical examples to illustrate materials, equipment or workmanship, and to establish standards by which completed work is judged.

B. Where size of samples is not specified, office samples should be of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of product or material, with integrally related parts and attachment devices.

2. After review, samples may be used in construction of Project.

C. Field Samples and Mockups:

1. Erect at Project site at location acceptable to State, unless otherwise approved.

2. Construct each sample or mockup complete, including work of all trades required in finished work.

2.06 SUBSTITUTIONS

A. State's Acceptance required:

1. Contract is based on materials, equipment and methods described in Contract Documents.

2. State will consider proposals for alternative materials, equipment and methods only when such proposals are accompanied by full and complete technical data and all other information required by State to evaluate proposed substitution.

3. Do not use alternative materials, equipment or methods unless such substitution has been specifically accepted for this work by the State.

4. Refer to General Conditions of the Contract for Construction, Subparagraph 3.12.10, Substitutions and Approved Equals, and Section 01 60 00, Product Requirements.

B. Coordination: Acceptance of substitution shall not relieve Contractor from responsibility for compliance with all requirements of the Drawings and Specifications, and Contractor shall be responsible at Contractor's own expense for changes in other parts of Contractor's work or work of others, including, but not limited to redesign costs of the Project which may be caused by acceptance of substitution.

C. Submit separate request for each product and support each request with:

1. Product identification.
2. Manufacturer's literature.
3. Samples, as applicable.

4. Comparison of proposed product with specified product.
5. Name and address of similar projects on which product has been used, and date of installation.

D. Submit data relating to changes in construction schedule, if any.

E. Substitute products shall not be ordered without written acceptance of the State.

F. The State will determine acceptability of proposed substitutions (alternatives) and reserves the right to reject proposals due to insufficient information.

2.07 CONSTRUCTION WASTE ESTIMATE

A. Submit Construction Waste Estimate form within 10 calendar days after the Start Date stated in the Notice to Proceed.

B. Refer to Section 01 74 19, Article 1.04 and Appendix 01 74 19.1, Construction Waste Estimate.

2.08 SUBMITTAL OF RECYCLED CONTENT CERTIFICATION

A. Product submittals from one or more of the eleven product categories as outlined in Section 01 74 20, Recycled Content Certification, shall be accompanied by a completed Recycled Content Certification Worksheet, Appendix 01 74 20.1.

B. An electronic copy of the form will be provided by the State at the Project start meeting, for Contractor's use.

C. Refer to Document 00 72 00, General Conditions of the Contract for Construction, Paragraph 3.21, Certification by Contractor of Recycled Content, and to Section 01 77 00, Closeout Procedures, for submittal of the State Agency Buy Recycled Campaign (SABRC) Procurement Report.

PART 3 - EXECUTION

3.01 SUBMISSION REQUIREMENTS

A. Schedule submissions at least three weeks before dates reviewed submittals will be needed and within the time periods specified in 3.01C. The State will review submittals within 21 calendar days unless the State notifies the Contractor in writing that a review of a specific submittal will take longer. Should the State review a submittal sooner, the Contractor shall not assume that a new timeline has been established.

B. The Contractor is herein made aware that deferred approval submittals, including but not limited to submittals requiring design review by the State’s consultants and/or controlling agencies, such as the SFM, OSHPD, DSA, will have longer review periods. The Contractor shall contact these agencies at the onset of the start of construction to determine the length of time for review, back-checks and approval and appropriately include this time in their Progress Schedule to avoid delays.

C. Except as otherwise specified for substitutions in Document 00 72 00, General Conditions of the Contract for Construction, Clause 3.12.10.1, and for certain other items in this Section 01 33 00, make submissions within the following number of days after the Start Date of the Work.

1. Items needed in initial stages of Work or requiring long lead-time for ordering: 30 calendar days.

2. Deferred Approval submittals, for review and approval by agencies such as SFM, OSHPD, DSA: 30 calendar days.

3. Electrical, mechanical and equipment items other than those covered by B.1. above: 60 calendar days.

4. All other items: 90 calendar days.

D. Identification: Identify submittals with names and location of Project, name of Contractor and work order and Contract numbers.

1. Submittals shall be accompanied by letter of transmittal addressed to State, to parties as identified in State's letter of instruction to be issued to Contractor at start of Project.

2. Each submittal shall be consecutively numbered and shall contain list of items submitted, properly identified as to drawing numbers, Specifications Section or other identification.

3. Submittals not adequately identified will be returned to Contractor for correction and resubmittal.

E. State will review submittals for conformance with contract documents: Acceptance of submittals by State covers only such conformance. Effort will be made by State to discover errors, but responsibility for accuracy and correction and resubmittal shall be the Contractor's.

F. Acceptance of submittals will be general and shall not relieve Contractor from responsibility for proper fitting and construction of Work, nor from furnishing materials and work required by Contract which may not be indicated on submittals.

G. No portion of work requiring submittals shall be commenced until submittal has been accepted by State. All such portions of work shall be in accordance with accepted submittals.

H. Number of copies required by State: Provide copies as follows; or greater quantity where so specified in individual Specification Sections. Add number of copies required by Contractor for Contractor’s distribution to the following numbers:

1. Progress Schedule, including Schedule of Values: One digital, pdf copy.

2. Certification: One digital copy

3. Shop Drawings: One digital copy and 2 prints of each original drawing.

4. Product Data/Material Lists: One 1 digital copy

5. Samples: As specifically indicated in pertinent Specification Section.

6. Samples for Color/Pattern Selection. One set of manufacturer's complete range for initial selection: and additional samples as requested of selected color/pattern for inclusion in final color schedule.

7. Substitutions: 1 digital, pdf copy required related data and information.

I. Submittals shall include:

1. Date and revision dates.
2. Project title and work order number.
3. Names of Contractor, subcontractor and supplier or manufacturer.
4. Identification of product or material.
5. Relation to adjacent structure or material.
6. Field dimensions, clearly identified as such.
7. Specification Section number.
8. Consecutive submittal number.
9. Blank space for State's stamp.
10. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.

END OF SECTION

SECTION 01 33 29.08

BUY CLEAN CALIFORNIA REPORTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements and procedures for reporting the embodied carbon emissions of construction materials used in public works projects.

B. Submit current facility-specific environmental product declaration for each eligible material proposed to be used on the Project.

1.02 DEFINITIONS

A. Environmental Product Declaration (EPD): Type III environmental impact label, as defined by the International Organization for Standardization (ISO) standard 14025, or similarly robust life cycle assessment methods that have uniform standards in data collection consistent with ISO standard 14025, industry acceptance, and integrity.

B. Facility-specific EPD: Product EPD in which the environmental impacts can be attributed to a single manufacturer and manufacturing facility.

C. Eligible Materials: Any of the following:

1. Carbon steel rebar.
2. Flat glass.
3. Mineral wool board insulation.
4. Structural steel.

1.03 SUBMITTALS

A. General: Buy Clean California submittals are required to be submitted along with other required submittal items for eligible materials as described in the Specifications.

B. Facility-specific Environmental Product Declaration: For each eligible material proposed to be used on the Project.

1. Facility-specific EPDs must comply with ISO 14025. An expired EPD will not be accepted.

C. Eligible Materials Cost Data: Prior to project closeout, provide statement indicating total cost for eligible materials used on the Project. Costs exclude labor, overhead, and profit. Include breakout of costs for each eligible material.

D. Eligible Materials Quantity Data: Prior to project closeout, provide statement indicating total quantity for eligible materials used on the Project. Include breakout of quantities for each eligible material.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

1.01 GENERAL

A. Requirements hereunder apply to alteration work shown on Drawings and specified in Sections pertaining to crafts or trades involved.

1.02 ALTERATIONS

A. Provide labor, materials, equipment and transportation as required to complete construction. Alteration work shall be performed by applicable crafts or trades involved.

1.03 REMOVAL WORK

A. Perform removal work, including wrecking and cutting necessary to alteration work, changing or elimination of old features, installation of new work, or joining and keying of new work to existing work. Items removed temporarily for convenience of Contractor shall be removed and replaced by Contractor, as approved.

1.04 ADJACENT SURFACES OR FEATURES

A. Replace, patch and finish in kind, adjacent surfaces or features displaced or disturbed in performance of alteration work. Broken and cut units shall be replaced with whole units.

B. Except as otherwise shown or specified, join new work to existing work to match similar existing adjoining work. Prepare existing surfaces to receive new work.

C. Prior to start of construction, in the presence of the State's Representative, Contractor shall provide digital CD/DVD w/audio and take digital photo documentation of existing conditions (Refer to Section 01 32 33 for additional requirements) and survey buildings and grounds affected by this Project and submit itemized list of defects, e.g. broken glass, window screens, salvage items, paving, walks, etc. Contractor shall make a copy of the video tape or CD/DVD and digital photos for Contractor's use and deliver the original to the State for use at Project close out. At completion of Project, defects not noted on that list or not verifiable on the CD/DVD or digital photos shall be corrected or replaced by Contractor at no cost to the State.

1.05 SALVAGED ITEMS

A. When specifically indicated, salvable items removed in alteration work may be reused; otherwise new items shall be provided. Removed items and materials not of value to State and not reused in the Work shall be disposed of off premises at Contractor's expense.

B. Salvaged items of value to State, and not reused in the Work, shall remain State property; store on site where directed. Salvaged items of value to State include: Please refer to drawings for any items that may need to be salvaged.

1.06 LAYOUT OF WORK

A. Establish exact layouts, locations, lines and elevations of work in relation to existing work. Obtain and verify measurements for new work in existing areas.

B. Refer also to Section 01 31 00, Project Management and Coordination.

1.07 PROTECTION OF EXISTING WORK AND NEW WORK

A. Provide protection against weather and construction operations for existing equipment, finishes, floors and floor coverings, furniture, fixtures, hardware and other improvements in and about altered areas.

1.08 SHORING, BRACING, UNDERPINNING

A. Provide temporary support for work as required by construction operations and to ensure safety.

1.09 INTERFERENCE

A. Interference with or inconvenience to occupants shall be kept to a minimum. Contractor shall, however, not be required by the State to work overtime.

1.10 NOISE

A. Noisy motors, cutting, drilling, and fastening equipment shall be operated without disturbance to occupants of the building or adjacent buildings.

1.11 DUST AND RUBBISH

A. Premises shall be kept clean and in a safe condition. Rubbish shall be removed as it accumulates.

B. Temporary dust-retarding partitions and barricades shall be built around work areas as indicated on the Drawings.

1.12 INTERRUPTION OF SERVICES

A. Interruption of electrical power for performance of work may be permitted only after consultation with the onsite State Representative. Temporary electrical power shall be provided to meet requirements of this Article. Added cost to Contractor due to necessity of complying with this Article shall be deemed to have been included in lump sum bid amount for Work of this Contract. Refer to requirements in Section 01 11 00 for interruption of services.

B. Contractor shall provide his own temporary construction lighting and power as required in areas where work is being performed, when normal site power is disrupted.

1.13 ACCESS, DELIVERY, AND HAULING

A. Materials and equipment shall be delivered and rubbish removed through passages designated by the State. Deliveries of materials and equipment to jobsite shall be made with a Contractor's representative present.

B. Keep corridors and entrances, for use of occupants, and reasonable access thereto, clear of building materials, refuse, and the like.

C. Refer to Section 01 60 00 for transportation, handling, and storage requirements.

1.14 CONSTRUCTION AREA

A. Contractor's employees, equipment, and materials shall be restricted to immediate area of construction.

1.15 CONSTRUCTION OFFICES/STAGING/STORAGE SPACE

A. Spaces used by Contractor and subcontractors for materials storage, staging and/or office space within building, shall be protected and restored before completion of Contract to prior existing or better than prior existing condition.

END OF SECTION

SECTION 01 41 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Regulatory Requirements

B. Inspection and Field Quality Control

C. Field Samples.

D. Manufacturers' Field Services and Reports.

E. Delegated Design Performance Requirements

1.02 RELATED DOCUMENTS AND SECTIONS

A. Document 00 72 00: General Conditions of the Contract for Construction.

B. Section 01 33 00: Submittal Procedures; Submission of Manufacturers' Instructions and Certificates.

C. Section 01 45 29: Testing Laboratory Services.

D. Section 01 60 00: Product Requirements; Requirements for material and product quality.

E. Pertinent Specification Sections.

1.03 REGULATORY REQUIREMENTS

A. Refer to Document 00 72 00, General Conditions of the Contract for Construction.

B. Refer to pertinent Specification Sections.

1.04 INSPECTION AND FIELD QUALITY CONTROL

A. Refer to Document 00 72 00, General Conditions of the Contract for construction.

B. Refer to pertinent Specification Sections.

1.05 FIELD SAMPLES

A. When Field Sample is required, perform no installation or application until Field Sample is approved.

B. Submit schedule for Field Sample construction; show date and relationship to Approved Contract Schedule.

C. Construct Field Samples required by individual Specifications Sections in locations as approved by the State.

D. The State will review Field Sample for conformance with Drawings and Specifications.

E. Modify or replace Field Sample until Field Sample is approved.

F. Approved Field Samples:

1. Shall remain until remainder of work of Section requiring Field Sample is complete.

2. Will be used as the standard of acceptable quality for that work for remainder of Project.

3. May be incorporated into the Work at the discretion of the State.

4. Shall be removed at completion of the work of that Section when required by Section or when not incorporated into the Work.

1.06 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. Submit qualifications of manufacturer's representative to the State 30 days in advance of required observations by manufacturer's representative. Manufacturer's representative is subject to approval of the State.

B. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report in duplicate within 30 days of observation to the State Representative for review.

1.07 DELEGATED DESIGN PERFORMANCE REQUIREMENTS

A. Qualifications

1. Engineer shall be a California licensed professional with current registration in the field and product requiring delegated design.

2. A minimum of five years of experience is required by the engineer responsible for the design, calculations, documentation, and engineering of the specification section requiring delegated design.

B. Submittals

1. All delegated design shall be stamped and signed by the California registered engineer responsible for the design, preparation and engineering of the fabrication and/or construction of the product or element requiring delegated design.

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. The State will employ and pay for services of an independent testing laboratory to perform specified testing for CCR Title 24.

1. Contractor shall cooperate with laboratory to facilitate execution of its required services.

2. Employment of laboratory shall in no way relieve Contractor's obligations to perform work of the Contract.

B. Contractor shall employ and pay for services for testing, adjusting, and balancing for HVAC specified under Section 23 05 93H.

1.02 RELATED REQUIREMENTS

A. Document 00 72 00: General Conditions of the Contract for Construction, Paragraph 3.13, Tests and Inspections: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.

B. Section 23 05 93H: Testing, Adjusting and Balancing for HVAC.

C. Individual Sections: Certification of products, Qualifications of testing, organizations and specific services required.

1.03 REQUIRED TESTS AND INSPECTIONS

A. By the State, CCR Title 24 Tests and Inspections: Except as noted otherwise, these tests and inspections shall be performed by State’s testing laboratory in conformance with State of California Code of Regulations (CCR), Title 24 as noted herein.

1. Structural Steel (Chapter 22, Title 24)
   a. Materials:
      (1) Material Identification.
      (2) Structural Steel.

   b. Tests and Inspection of Structural Steel:
      (1) Tests of Structural and Cold Formed Steel.
      (2) Shop Fabrication Inspection.
      (3) Welding Inspection.
      (4) Welding of Reinforcing Bars.

B. By the Contractor, Testing, Adjusting, and Balancing of Systems: These services shall be provided by approved testing organization in conformance with requirements for services specified in individual sections pertaining to each system.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work and to manufacturer's operations.

B. Provide to laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to laboratory preliminary design mix proposed to be used for concrete, and other material mixes which require control by testing laboratory.

D. Furnish copies of products test reports as required.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.

2. To obtain and handle samples at Project site or at source of product to be tested.

3. To facilitate inspections and tests.

4. For storage and curing of test samples.

F. Notify State's Inspector 48 hours in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspections cannot be performed after such notice, reimburse the State for laboratory personnel and travel expenses incurred due to Contractor's negligence.

G. When additional testing services are needed for Contractor's convenience, employ and pay for services of separate, equally qualified independent testing laboratory; or make arrangements with State's laboratory and pay for additional samples and tests required for Contractor's convenience.

H. The State or its representative shall have the right to reject materials and workmanship which are defective or to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the State. If Contractor does not correct such rejected work within a reasonable time, fixed by written notice, the State may correct same and charge the expense to Contractor.

I. Should it be considered necessary or advisable by the State at any time before Acceptance of the Work to make examination of work already completed by removing or tearing out same, Contractor shall, on request, promptly furnish necessary facilities, labor and materials. If such work is found to be defective in any respect due to fault of Contractor or subcontractor, shall defray all expenses of such examinations and of satisfactory reconstruction. If, however, such work is found to meet requirements of the Contract, additional cost of labor and material necessarily involved in the examination and replacement will be allowed the Contractor.

END OF SECTION

SECTION 01 51 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish and install temporary facilities as hereunder specified, plus other unspecified temporary facilities, including labor, materials, services, utilities, and equipment, as may be required for proper performance of Work, except as otherwise provided. Temporary facilities shall be approved by the State and other authorities having legal jurisdiction. Locate facilities where and as directed, and maintain in safe and sanitary condition at all times until completion of Work.

1.02 RELATED REQUIREMENTS

A. Document 00 72 00: General Conditions of the Contract for Construction.

B. Section 01 31 00: Project Management and Coordination

C. Section 01 74 19: Construction Waste Management.

E. Section 01 74 23: Cleaning

F. Section 01 77 00: Closeout Procedures.

1.03 FIELD OFFICE

A. Field Office for State: Not required. The State will provide its own field office facilities.

B. Contractor's Field Office: Contractor may provide field office facilities for Contractor's use as desired. Contractor's field office shall be neat and substantial, and all expenses therefor shall be paid by Contractor.

C. Telephone Service: The State will provide and pay for telephone service for its own use.

D. Telephone service required by Contractor shall be provided and paid for by Contractor, if, and as needed in performance of Work.

1.04 CONSTRUCTION EQUIPMENT

A. Erect, equip, operate, and maintain construction equipment in strict accordance with applicable statutes, laws, ordinances, rules, and regulations of authorities having jurisdiction.

B. Provide and maintain scaffolding, staging, runways, and similar equipment, as needed.

1.05 SAFETY PRECAUTIONS

A. Provide and maintain barricades, fencing, shoring, pedestrian walkways, including attached lights, other lights, and other safety precautions to properly guard against personal injury and property damage as prescribed by authority having jurisdiction. (See also General Conditions, Article 10.).

B. Wood fences, barricades, walkways, and similar items shall be painted 2 coats; color as directed by the State.

C. Attention is directed to Safety Orders issued by State of California, Division of Industrial Safety. Contractor shall obtain copies of Safety Orders applicable to type of work to be performed, and shall be governed by requirements thereof in construction operations.

D. Fully inform each subcontractor and material supplier as to requirements of applicable Safety Orders. (See General Conditions, Article 10.).

1.06 ROADS AND ACCESSWAYS

A. Entrance to Work Site: Contractor and Contractor's employees and subcontractors shall use certain access roads or entrance ways as indicated on Plans or as directed by State.

B. Maintain these roads in satisfactory condition during Contract time, and repair damages attributable to Work of this Project at intervals as needed. At completion of Contract, roads and entrance ways shall be left in condition at least equal to that existing at start of Contract, except as may be otherwise required by Contract documents.

1.07 USE OF STATE PROPERTY

A. On Site Storage and Work Areas: The State will allocate available on site storage and work areas to Contractor, subject to change as may be necessary by job progress, such as site development or other intervening work.

B. State Property: Except as otherwise shown or specified, Work operations shall be confined to State property and shall not encroach on areas other than those designated or approved for such use by State. (See General Conditions, Paragraph 3.14.).

C. Ascertain, observe, and comply with rules and regulations in effect at occupied State facilities, including, but not restricted to, parking and traffic regulations, security restrictions, hours of allowable ingress and egress as to main arteries, occupied buildings, and the like.

D. Protection of Existing Utilities: Protect from damage, existing utility lines not specified to be altered by Work of this Contract; any such features damaged shall be repaired or replaced to condition equal to that existing prior to commencing work of this Contract. (See also General Conditions, Paragraphs 3.1 and 10.1).

1.08 SIGNS

A. Signs or Advertising: Not permitted, except that Contractor's name may be placed on field office.

1.09 CLEAN UP OF WORK AND DISPOSAL OF TRASH

A. Attention of Contractor is directed to General Conditions, Paragraph 3.16, and Specification Sections 01 74 23 and 01 77 00. Keep work and storage areas clean and free of rubbish and perform protective and clean up work within one day of being so notified by State.

B. Dispose of trash resulting from work, off State property, as it accumulates. Pay fees required for use of public dumps. Burning on State property is prohibited.

1.10 SANITARY FACILITIES

A. Toilet Facilities: Provide sufficient suitably enclosed chemical toilets, conforming to ANSI Z4.3., with urinal for workers.

B. Washing Facilities: Provide properly mounted and adequate wash sinks connected to water supply. Locate sinks where directed by State.

C. Drinking Water Facilities: Provide clean, sanitary and adequate drinking water.

1.11 TEMPORARY WATER

A. Make arrangements for water required for construction purposes; furnish and install temporary piping or hose to carry water to every part of construction.

1.12 TEMPORARY ELECTRICAL FACILITIES

A. Provide such temporary electrical facilities as are necessary to supply temporary lighting for work operations and temporary power for portable power driven tools and other Contractor equipment.

B. Temporary power at 120V is available from existing sources at site and will be free of charge for construction operations.

1.13 TEMPORARY HEAT

A. Provide and pay all costs for temporary heat, including equipment, fuel, and operators which may be required during Contract time to provide adequate temperatures for storage, application, and drying of installed materials.

B. Provide temporary closures for windows and doors, and temporary general building ventilation, for proper storage and drying of materials and safe working conditions.

1.14 SECURITY

A. Contractor is responsible for security of work areas involved in this Project, during entire time of Contract. Make good all damages to work and loss of materials due to vandalism or theft, within this responsibility.

1.15 TEMPORARY DOMESTIC HOT WATER FACILITIES

A. Provide 4 skid-mounted portable domestic hot water heating units for use when steam to residential units or Acute Care Hospital is interrupted.

B. Each unit shall consist of 99 gallon capacity D.O.T. propane cylinder, 333 MBH input water heater, 175 gallon storage tank, pump, piping, and appurtenances mounted on fabricated steel base; as scheduled and detailed on Drawings.

C. Upon completion of Project, temporary water heating units shall be delivered to Facility Operations and Maintenance Department.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. This Section describes basic requirements governing products including:

1. Workmanship.

2. Manufacturers' instructions.

3. Transportation and handling.

4. Storage and protection.

5. Substitutions

1.02 RELATED REQUIREMENTS

A. Document 00 72 00: General Conditions of the Contract for Construction.

B. Section 01 33 00: Submittal Procedures.

C. Section 01 77 00 - Closeout Procedures: Operation and maintenance data; warranties and bonds.

1.03 PRODUCTS

A. Products include material, equipment, and systems.

B. Comply with specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a Specification Section shall be the same, and shall be interchangeable.

D. Reference to materials or methods of construction by name and catalog number is done to establish standards of quality, design, utility, suitability, and cost, and shall not be construed as limiting competition.

E. Where the words "or equal" are used following trade names, patented products, or proprietary products or methods, they shall be deemed to read "or equal in quality, design, utility and suitability"; as solely determined by the State. Where such trade names, products, or methods are without the use of the words "or equal", they shall be deemed to be followed by the words "or equal in quality, design, utility and suitability" as solely determined by the State.

F. Materials and methods of equal standards will be accepted for use if first deemed equal, and approved by the State.

1.04 QUALITY ASSURANCE

A. Comply with industry standards except when more restrictive tolerances or requirements indicate more rigid standards or greater quality.

B. Perform work by persons qualified to produce specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.05 MANUFACTURERS' INSTRUCTIONS

A. When work is specified to comply with manufacturers' instructions, submit copies as specified in Section 01 33 00, distribute copies to persons involved, and maintain one set in field office.

B. Perform work in accordance with details of instructions and specified requirements. Should conflict exist between Specifications and instructions, consult with Project Director.

1.06 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage, deliver in undamaged condition in manufacturer's unopened containers or packaging.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

1.07 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weathertight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering, provide ventilation to avoid condensation.

C. Store loose granular materials on solid surfaces in well-drained area; prevent mixing with foreign matter.

D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and maintained under required conditions.

E. After installation, provide coverings to protect products from damage from traffic and construction operations, remove when no longer needed.

1.08 SUBSTITUTIONS (ALTERNATIVES)

A. Refer to Document 00 72 00, General Conditions of the Contract for Construction, Subparagraph 3.12.10, and Section 01 33 00, Submittal Procedures.

END OF SECTION

SECTION 01 64 00

OWNER-FURNISHED EQUIPMENT

PART 1 MODULAR SYSTEMS FURNITURE

1.01 REQUIREMENTS INCLUDED

A. The State will provide and install new and/or used Modular Systems Furniture (MSF) and Mobile Book Shelving.

1. Contractor shall cooperate with State's installers to facilitate the execution of the MSF installers' required services.

2. Contractor shall have specific components of MSF installation to perform.

1.02 RELATED REQUIREMENTS

A. 09 68 13 "Tile Carpeting" for carpet tiles installed on the new mobile book shelving platform
B. Division 26 for power/data floor and wall outlet coordination.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall include MSF installation in Contractor's baseline and progress construction schedules.
1. The State's installation duration for MSF is 45 calendar days.

2. Installation of MSF shall not take place until construction of tenant improvements are complete within the areas of delivery and installation.

B. Contractor shall attend State-arranged pre-installation meeting(s) for MSF at the project site.

1. Contractor's electrical and tele/data sub-contractors must attend pre-installation meeting(s).

C. Contractor shall provide suitable, clean staging area(s) adjacent to installation area for MSF product prior to, and during, installation.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. General requirements for cutting, fitting and patching of the work to:

1. Make the several parts fit properly.

2. Uncover work to provide for installation, inspection, or both, of ill-timed work.

3. Remove and replace work not conforming to requirements of the Contract Documents.

4. Remove and replace defective work.

5. Reworking and patching to match existing surfaces at removed or demolished items.

1.02 RELATED REQUIREMENTS

A. Document 00 72 00: General Conditions of the Contract for Construction; Paragraph 3.15, Cutting and Patching.

1.03 QUALITY ASSURANCE

A. Patching shall achieve security, strength, and weather protection, and shall preserve continuity of existing fire ratings.

B. Patching shall successfully duplicate undisturbed adjacent finishes, colors, textures, and profiles. Where there is dispute as to whether duplication is successful or has been achieved to a reasonable degree, the State's judgment shall be final.

PART 2 - PRODUCTS

2.01 MATERIALS

A. For replacement of work removed, use only materials which comply with pertinent Sections of these Specifications.

2.02 PAYMENT FOR COSTS

A. Perform cutting and patching required to comply with the Contract Documents at no additional cost to the State.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, backfilling, and patching.

B. After uncovering the work, inspect conditions affecting installation of new work.

3.02 INSTALLATION

A. Perform cutting and patching in a manner to prevent damage to other work and to provide proper surfaces for the installation of materials, equipment, and repairs.

B. Do not cut nor alter structural members without prior approval of the State.

C. Adjust and fit products to provide a neat installation.

D. Finish or refinish, as required, cut and patched surfaces to match adjacent finishes. Paint over complete surface plane, unless otherwise indicated. Over patched wall or ceiling surfaces, paint to nearest cut-off line for entire surface, such as intersection with adjacent wall or ceiling, beam, pilasters, or to nearest opening frame, unless otherwise indicated. Painted surfaces shall not present a spotty, touched-up appearance.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Waste Management Objective for the Project:

1. The State has established that this Project shall minimize the generation of construction and demolition waste at the site. Factors that contribute to waste, such as over-packaging, improper storage, ordering error, poor planning, breakage, mishandling, and contamination shall be minimized.

2. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be reused or recycled. Waste disposal in landfills shall be minimized.

B. Diversion from Landfill: Waste categories appropriate for diversion from landfill shall include, but not be limited to, the following:

1. Land clearing debris
2. Soil
3. Wood: Clean dimensional wood, palette wood
4. Sheet Wood: Plywood, OSB and particle board
5. Concrete
6. Bricks
7. Concrete Masonry Units (CMU)
8. Asphalt Concrete
9. Paper
    a. Bond
    b. Newsprint
    c. Cardboard and paper packaging materials
10. Cement Fiber Products: Shingles, panels, and siding
11. Metals
    a. Ferrous
    b. Non-ferrous
12. Paint
13. Rigid Foam
14. Glass
15. Plastics
16. Carpet and pad
17. Beverage containers
18. Insulation
19. Gypsum Board
20. Porcelain Plumbing Fixtures
21. Fluorescent Light Tubes (per Department of Toxic Substances Control regulations)

1.02 RELATED REQUIREMENTS

A. Appendix 01 74 19.1: Construction Waste Estimate.

B. Appendix 01 74 19.2: Waste Management Report.

C. Section 01 33 00: Submittal Procedures.

D. Section 01 74 23: Cleaning.

E. Section 01 77 00: Closeout Procedures.

1.03 REFERENCES

A. The California Department of Resources Recycling and Recovery (CalRecycle); Telephone (916) 341-6300; https://www.calrecycle.ca.gov/ConDemo.

B. Local Integrated Waste Management Programs and Re-Use Programs in the Project area.

C. The Department of Toxic Substances Control (DTSC)

1.04 CONSTRUCTION WASTE ESTIMATE

A. Within 10 calendar days after Start Date of the Work, or prior to any waste removal, whichever occurs sooner, the Contractor shall submit to the State a Construction Waste Estimate, using the Construction Waste Estimate form included as Appendix 01 74 19.1; containing the following information:

1. Estimate of total job site wastes to be generated, including material types and quantities.
2. Estimate of percentages of waste categories to landfill, to be reused, and to be recycled.

B. The State will provide an electronic copy of Appendix 01 74 19.1 for Contractor's use.

C. Submit Construction Waste Estimate under provisions of Section 01 33 00.

1.05 WASTE MANAGEMENT

A. Manager: Contractor shall designate on-site party (or parties) responsible for instructing workers and subcontractors, and overseeing and documenting results of Waste Management for the Project.

B. Distribution: Contractor shall distribute copies of the Construction Waste Estimate and Waste Management Report forms to the Job Site Foreman, each Subcontractor, and the State’s Representative.

C. Meetings: Contractor shall conduct Waste Management meetings with subcontractors who generate construction waste. Contractor shall present current status of the Waste Management Report at regular job-site meetings.

D. Materials Handling Procedures: Provide means by which waste materials will be protected from contamination, and means to be employed in reuse or recycling of waste material consistent with requirements for acceptance by receiving facilities.

1. Separation Facilities: Contractor shall lay out and label a specific area to facilitate separation of materials for reuse and recycling. Recycling and waste bin areas shall be kept neat and clean and clearly marked in order to avoid contamination of materials.

2. Hazardous Wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations, and in accordance with specifications for such work as may be included in this Project.

3. Instruction: Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at appropriate stages of the Project.

1.06 WASTE MANAGEMENT REPORT

A. Upon completion of Work, including final cleanup, provide a final Waste Management Report containing the information required on Appendix 01 74 19.2, Waste Management Report forms.

1. The total quantity of each waste material generated; and the date(s) removed from the job-site.

2. The percent of the total quantity generated of each material sent to landfill, the identity of the landfill (receiving facility), handling costs, transport costs, tipping fees paid at the landfill, and total landfill costs. Attach copies of manifests, weight tickets, receipts, and invoices.

3. For each material reused or recycled from the Project, include the percent of the total quantity generated, the identity of the receiving facility, the total costs of handling and transportation, and income. Attach manifests, weight tickets, receipts, and/or invoices.

4. Contractor shall edit and use forms included in Appendix 01 74 19.2, Waste Management Report, or use them as a basis for Contractor’s forms.

5. The State will provide electronic copies of Appendix 01 74 19.2 for Contractors' use.

B. Submit Waste Management Report under provisions of Section 01 77 00.

END OF SECTION

CONSTRUCTION WASTE ESTIMATE

Date: _____

Waste Material (Edit to Suit)	Unit	Estimated Quantity Generated	Percent to Landfill	Percent Reused	Percent Recycled
Land Clearing Debris	CY				
Soil	CY				
Wood	CY				
Sheet Wood	CY				
Concrete	CY				
Bricks	CY				
Concrete Masonry Units	CY				
Asphalt Concrete	CY				
Paper	CY				
Cement Fiber Products	CY				
Metal (ferrous)	TON				
Metals (non-ferrous)	LBS				
Paint	GAL				
Rigid Foam	CF				
Glass	CF				
Plastics	CF				
Carpet and Pad	SY				
Beverage Containers	LBS				
Insulation	CF				
Gypsum Board	CF				
Porcelain Plumbing Fixtures	EA				
Fluorescent Light Tubes	EA				

WASTE MANAGEMENT REPORT
QUANTITIES

Waste Material (Edit to Suit)	Unit	Date Removed	Total Quantity Generated	Percent to Landfill	Percent Reused	Percent Recycled
Land Clearing Debris	CY					
Soil	CY					
Wood	CY					
Sheet Wood	CY					
Concrete	CY					
Bricks	CY					
Concrete Masonry Units	CY					
Asphalt Concrete	CY					
Paper	CY					
Cement Fiber Products	CY					
Metal (ferrous)	TON					
Metals (non-ferrous)	LBS					
Paint	GAL					
Rigid Foam	CF					
Glass	CF					
Plastics	CF					
Carpet and Pad	SY					
Beverage Containers	LBS					
Insulation	CF					
Gypsum Board	CF					
Porcelain Plumbing Fixtures	EA					
Fluorescent Light Tubes	EA					

WASTE MANAGEMENT REPORT
COST / INCOME

Waste Material (Edit to Suit)	Unit	Receiving Facility	Landfill Cost			Reused		Recycled	
			Handling	Transport	Fee	Cost	Income	Cost	Income
Land Clearing Debris	CY								
Soil	CY								
Wood	CY								
Sheet Wood	CY								
Concrete	CY								
Bricks	CY								
Concrete Masonry Units	CY								
Asphalt Concrete	CY								
Paper	CY								
Cement Fiber Products	CY								
Metal (ferrous)	TON								
Metals (non-ferrous)	LBS								
Paint	GAL								
Rigid Foam	CF								
Glass	CF								
Plastics	CF								
Carpet and Pad	SY								
Beverage Containers	LBS								
Insulation	CF								
Gypsum Board	CF								
Porcelain Plumbing Fixtures	EA								
Fluorescent Light Tubes	EA								
		TOTALS:							

SECTION 01 74 20

RECYCLED CONTENT CERTIFICATION

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Recycled Content Reporting for the Project:

1. The State has established that all Projects shall document and report the percentage of recycled content in materials, products, equipment and furnishings actually installed and provided for this Project.
2. The State Agency Buy Recycled Campaign (SABRC) is a joint effort between the Department of General Services and the California Department of Resources Recycling and Recovery (CalRecycle) to implement State law. Public Contract Code (PCC) sections 12200–12320 require State agencies to purchase recycled-content products (RCP) instead of non-recycled-content products (non-RCP) in eleven (11) product categories, to ensure that a minimum percentage of purchases in those categories have recycled content, and report these purchases annually to CalRecycle. The certification and reporting will be utilized to comply with those requirements.
3. All products that can be classified as being in one of the eleven (11) categories must be included in the reporting, whether the product is a RCP or non-RCP. Only products that can be classified in one of the categories shall be reported.

B. Recycled Content Categories: Categories identified for purchasing and reporting of products:

1. Paper products.
2. Printing and writing papers.
3. Mulch, compost, and cocompost products.
4. Glass products.
5. Lubricating oils.
6. Plastic products.
7. Paint.
8. Antifreeze.
9. Tires.
10. Tire-derived products.
11. Metal.

1.02 RELATED REQUIREMENTS

A. Section 00 72 00: General Conditions of the Contract for Construction

B. Section 01 33 00: Submittal Procedures.

C. Section 01 77 00: Closeout Procedures.

1.03 REFERENCES

A. CalRecycle:
1. State Agency Buy Recycled Campaign: CalRecycle Publications Catalog Search. Access this website for information on the Buy Recycled Campaign.
2. Construction and Demolition Debris Recycling. Access this website for information on the Construction Waste/Demolition.

1.04 DEFINITIONS

A. Recycled Content Product (RCP): All materials, goods, and supplies that are from one of the eleven (11) Product Categories that contains the minimum percentages of secondary and postconsumer materials stipulated in the Recycled Content Certification Worksheet footnotes.

B. Non-Recycled Content Product (non-RCP): All materials, goods, and supplies that are from one of the eleven (11) Product Categories having no recycled content or less than the minimum percentages of secondary and postconsumer materials stipulated in the Recycled Content Certification Worksheet footnotes.

1.05 RECYCLED PRODUCT CERTIFICATION

A. With each product submittal from one of the eleven (11) Product Categories, submit a Recycled Content Certification Worksheet, Appendix 01 74 20.1, containing the following information:

1. Product Description, with applicable specification section of product.
2. Estimated material dollar value including any taxes and delivery cost.
3. Designate the Product Category for each product listed.
4. Estimate of percentage of material content.
5. Designate whether or not product is a Recycled Content Product.
6. Attach a copy of the manufacturer's or vendor's data sheet showing recycled content percentages if product is reported as a Recycled Content Product.

B. An example of a completed Recycled Content Certification Worksheet is attached as Appendix 01 74 20.1 for Contractor's reference. An electronic version of this Worksheet for Contractor's use will be provided by the State at the Project start meeting.

1.06 CLASSIFICATION OF PRODUCTS

A. RCP's and non-RCP's that are made from multiple material types should be reported in the product category of the material type representing most of the product.

1.07 STATE AGENCY BUY RECYCLED CAMPAIGN PROCUREMENT SUMMARY

A. Manager: Contractor shall designate an individual responsible for instructing suppliers and subcontractors, and overseeing and documenting results of Recycled Content Certification for the Project. Manager shall document results of submitted Recycled Content Certification Worksheets on the SABRC Procurement Summary, Appendix 01 74 20.2, in total for each product category. Only reportable products from one of the eleven (11) categories should be recorded.

B. An example of a completed SABRC Procurement Summary is attached as Appendix 01 74 20.2 for Contractor's reference. An electronic version of this Worksheet for Contractor's use will be provided by the State after Award of contract.

C. Distribution: Manager shall provide copies of the SABRC Procurement Summary at intervals agreed to by the State's Representative for monitoring of the program. At the conclusion of the construction submittals and prior to final payment, Manager shall provide a copy of the final SABRC Procurement Summary under provisions of Section 01 77 00.

END OF SECTION

Recycled-Content Certification Worksheet

This form must be completed by contractor. The contractor must submit worksheet with each product submittal to the State agency, with a row completed for each product supplied to the State. Attach additional sheets if necessary. Information must be included, even if the product does not contain recycled-content material but it is within one of the 11 categories. Refer to footnotes following this form.

CONTRACTOR'S / VENDOR'S NAME: XYZ CONTRACTORS **DATE:** FEBRUARY 5, 2019

ADDRESS: 4300 PLEASANT VALLEY DR., LINCOLN LOGS, CA 95000 **PROJECT DIRECTOR:** (AS NAMED)

PHONE: (XXX) XXX-XXXX **FAX**: (XXX) XXX-XXXX

Product Description/ Specification Section	Quantity	Estimated Dollars	Product Category[1]	RCP Y/N?	Virgin Content (Percent)[2]	Postconsumer Material (Percent)[3]	Secondary Material (Percent)[4]	Total Percent[5]
High Impact Resistant Gypsum Board, 09260	N/A	$2,500	Paper	Y	50	10	40	100%
Cellulose Building Insulation, 07213	N/A	$10,000	Paper	Y	20	10	70	100%
Underslab Vapor Barrier, 03300	N/A	$1,500	Plastic	Y	20	20	60	100%
Electrical Cover Plates, 16010	N/A	$2,500	Plastic	N	90	0	10	100%
Interior and Exterior Paint, 09900	300gal	$8,000	Paint	N	100	0	0	100%
Recessed Entrance Mats, 10420	N/A	$1,800	Tire Derived	Y	40	20	40	100%
Ceramic Tile, 09310	N/A	$5,000	Glass	Y	35	10	55	100%
Exterior and Interior Windows, 08800	N/A	$30,000	Glass	N	70	10	20	100%
Metal Studs, 09206	N/A	$6,000	Metal	Y	65	15	10	100%

Public Contract Code sections 10233, 10308.5, and 10354 require all vendors and contractors to certify in writing, under penalty of perjury, the minimum, if not the exact, percentage of postconsumer and secondary material in the products, materials, goods, or supplies provided or used.

Public Contract Code section 12205 (a) requires all State agencies to require all contractors to certify in writing, under penalty of perjury, the minimum, if not the exact percentage, of postconsumer and secondary material in the products, materials, goods, or supplies provided or used.

Printed name of person completing form Title Signature of person completing form

Footnotes

You must submit copies of this form and/or other documentation for each product that is reportable.

1. Product category refers to one of the product categories into which the reportable product purchase falls. For products made from multiple materials, choose the category that comprises most of the product, either by a weight or volume criteria. The product categories and corresponding content requirements are defined as follows:
   1. Paper products
   2. Printing and writing papers
   3. Mulch, compost and cocompost.
   4. Glass products
   5. Lubricating oils
   6. Plastic products
   7. Paint
   8. Antifreeze
   9. Tires
   10. Tire-derived products
   11. Metal

   Recycled-content printing and writing papers (PWP) include copy paper and xerographic papers of all colors, and higher-grade papers such as watermarked and cotton fiber papers. High-speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, ruled tablets, calendars, posters, manila file folders, index cards, white wove envelopes, and other uncoated printing and writing paper such as writing and office paper, book paper, cotton-fiber paper **(containing 25–75 percent cotton fiber)**, and cover stock are all included in the PWP category.

   Recycled metal product means flat rolled metal products with **at least 25 percent** of the total weight consisting of secondary and postconsumer material, with **not less than 10 percent** postconsumer material. Products made with flat rolled metal meeting these content percentages may include automobiles, cans, appliances, and office furniture and supplies.

   Recycled-content product (RCP) for paper products, plastic products, glass products, tires, tire-derived products, compost and co-compost, lubricating oil, paints, solvents, is defined in PCC section 12200 (SB 1915, 1994) as containing **at least 50 percent** of the total weight of which consists of secondary and postconsumer material with **not less than 10 percent** of its total weight consisting of postconsumer material. This definition applies to all product categories that do not have specific statutory definitions.

2. Virgin material content is that portion of the product made from non-recycled material, that is, the material is neither secondary nor postconsumer material.

3. Postconsumer material is defined as “a finished material which would have been disposed of as a solid waste, having completed its life cycle as a consumer item, and does not include manufacturing wastes.” This is material such as newspaper that you read and was recycled and then made into recycled-content newsprint or some other recycled product. Postconsumer material is generally any product that was bought by the consumer, used, and then recycled into another product.

4. Secondary material is defined as “fragments of finished products or finished products of a manufacturing process, which has converted a resource into a commodity of real economic value, and includes postconsumer material, but does not include excess virgin resources of the manufacturing process.” This is material such as newsprint that is trimmed from a roll in the paper plant that is returned to the beginning of the process to make recycled-content newsprint. The material (product) did not get to the consumer before being recycled.

   For example, if a printing and writing paper contained 20 percent postconsumer material, you would indicate 20 percent in the postconsumer column and 80 percent in the virgin column. If the product had 40 percent secondary material and 20 percent postconsumer material, you would

indicate 40 percent in the secondary column, 20 percent in the postconsumer column, and 40 percent in the virgin column. To meet the 50/10 content requirement of another product category, the product would contain 50 percent recycled-content (40 percent secondary and 10 percent postconsumer material) and 50 percent virgin material.

5. The sum of the virgin column, the postconsumer column, and the secondary column must equal 100 percent.

Note: Products that are made from multiple material types should be reported in the product category of the material type representing most of the product. The amount of material used in the product can be measured by weight or volume. If, for instance, a chair is made from steel, aluminum, and plastic and most of the material, either by weight or volume, is plastic, report it as a plastic product. If, however, most of the product, either by weight or volume, is metal, report the purchase as a metal product.

PROJECT NAME: _____ PROJECT NO.: _____

Recycled-Content Certification Worksheet

This form must be completed by contractor. The contractor must submit worksheet with each product submittal to the State agency, with a row completed for each product supplied to the State. Attach additional sheets if necessary. Information must be included, even if the product does not contain recycled-content material but it is within one of the 11 categories. Refer to footnotes following this form.

CONTRACTOR'S / VENDOR'S NAME: _____ **DATE:** _____

ADDRESS: _____ **PROJECT DIRECTOR:** _____

PHONE: _____ **FAX:** _____

Product Description/ Specification Section	Quantity	Estimated Dollars	Product Category[1]	RCP Y/N?	Virgin Content (Percent)[2]	Postconsumer Material (Percent)[3]	Secondary Material (Percent)[4]	Total Percent[5]
								100%
								100%
								100%
								100%
								100%
								100%
								100%
								100%

Public Contract Code sections 10233, 10308.5, and 10354 require all vendors and contractors to certify in writing, under penalty of perjury, the minimum, if not the exact, percentage of postconsumer and secondary material in the products, materials, goods, or supplies provided or used.

Public Contract Code section 12205 (a) requires all State agencies to require all contractors to certify in writing, under penalty of perjury, the minimum, if not the exact percentage, of postconsumer and secondary material in the products, materials, goods, or supplies provided or used.

_____

Printed name of person completing form | Title | Signature of person completing form

Footnotes

You must submit copies of this form and/or other documentation for each product that is reportable.

1. Product category refers to one of the product categories into which the reportable product purchase falls. For products made from multiple materials, choose the category that comprises most of the product, either by a weight or volume criteria. The product categories and corresponding content requirements are defined as follows:
   1. Paper products
   2. Printing and writing papers
   3. Mulch, compost and cocompost.
   4. Glass products
   5. Lubricating oils
   6. Plastic products
   7. Paint
   8. Antifreeze
   9. Tires
   10. Tire-derived products
   11. Metal

   Recycled-content printing and writing papers (PWP) include copy paper and xerographic papers of all colors, and higher-grade papers such as watermarked and cotton fiber papers. High-speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, ruled tablets, calendars, posters, manila file folders, index cards, white wove envelopes, and other uncoated printing and writing paper such as writing and office paper, book paper, cotton-fiber paper **(containing 25–75 percent cotton fiber)**, and cover stock are all included in the PWP category.

   Recycled metal product means flat rolled metal products with **at least 25 percent** of the total weight consisting of secondary and postconsumer material, with **not less than 10 percent** postconsumer material. Products made with flat rolled metal meeting these content percentages may include automobiles, cans, appliances, and office furniture and supplies.

   Recycled-content product (RCP) for paper products, plastic products, glass products, tires, tire-derived products, compost and co-compost, lubricating oil, paints, solvents, is defined in PCC section 12200 (SB 1915, 1994) as containing **at least 50 percent** of the total weight of which consists of secondary and postconsumer material with **not less than 10 percent** of its total weight consisting of postconsumer material. This definition applies to all product categories that do not have specific statutory definitions.

2. Virgin material content is that portion of the product made from non-recycled material, that is, the material is neither secondary nor postconsumer material.

3. Postconsumer material is defined as “a finished material which would have been disposed of as a solid waste, having completed its life cycle as a consumer item, and does not include manufacturing wastes.” This is material such as newspaper that you read and was recycled and then made into recycled-content newsprint or some other recycled product. Postconsumer material is generally any product that was bought by the consumer, used, and then recycled into another product.

4. Secondary material is defined as “fragments of finished products or finished products of a manufacturing process, which has converted a resource into a commodity of real economic value, and includes postconsumer material, but does not include excess virgin resources of the manufacturing process.” This is material such as newsprint that is trimmed from a roll in the paper plant that is returned to the beginning of the process to make recycled-content newsprint. The material (product) did not get to the consumer before being recycled.

   For example, if a printing and writing paper contained 20 percent postconsumer material, you would indicate 20 percent in the postconsumer column and 80 percent in the virgin column. If the product had 40 percent secondary material and 20 percent postconsumer material, you would indicate 40 percent in the secondary column, 20 percent in the postconsumer column, and 40 percent in the virgin column. To meet the 50/10

content requirement of another product category, the product would contain 50 percent recycled-content (40 percent secondary and 10 percent postconsumer material) and 50 percent virgin material.

5. The sum of the virgin column, the postconsumer column, and the secondary column must equal 100 percent.

Note: Products that are made from multiple material types should be reported in the product category of the material type representing most of the product. The amount of material used in the product can be measured by weight or volume. If, for instance, a chair is made from steel, aluminum, and plastic and most of the material, either by weight or volume, is plastic, report it as a plastic product. If, however, most of the product, either by weight or volume, is metal, report the purchase as a metal product.

State Agency Buy Recycled Campaign Procurement Summary

Attach copies of the recycled-content certification form(s) and/or other documentation for each product that contains any amount of recycled material.

CONTRACTOR'S / VENDOR'S NAME: XYZ CONTRACTORS **DATE:** FEBRUARY 5, 2019

ADDRESS: 4300 PLEASANT VALLEY DR., LINCOLN LOGS, CA 95000 **PROJECT DIRECTOR:** (AS NAMED)

PHONE: (XXX) XXX-XXXX **FAX**: (XXX) XXX-XXXX

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Product Category[1]	**All Reportable Purchases (QUANTITY)[2]**	**All Reportable Purchases (DOLLARS)[3]**	**RCP Purchases (QUANTITY)[4]**	**RCP Purchases (DOLLARS)[5]**	**Percent of RCP (QUANTITY)[6]**	**Percent of RCP (DOLLARS)[7]**
Paper products		$ 18,000.00		$ 12,500.00		70%
Printing and writing paper		$ 0.00		$0.00		0%
Mulch, compost and cocompost	0(cu yd)	$ 0.00	0(cu yd)	$ 0.00	0%	0%
Glass products		$ 35,000.00		$ 5,000		14%
Lubricating oils	0(gal)	$ 0.00	0(gal)	$ 0.00	0%	0%
Plastic products		$ 4,000.00		$ 1,500.00		38%
Paint	300(gal)	$ 8,000.00	300(gal)	$ 0.00	0%	0%
Antifreeze	0(gal)	$ 0.00	0(gal)	$ 0.00	0%	0%
Tires	0	$ 0.00	0	$ 0.00	0%	0%
Tire-derived products		$ 2,000.00		$ 2,000.00		100%
Metal		$ 11,000.00		$ 6,000.00		54%
		Total[8]: $ 78,000		**Total[9]: $ 27,000**		**Total[10]: 34.6%**

(See footnotes on the back of this page.)

Footnotes

Attach copies of the recycled-content certification forms and/or other documentation for each product.

Note: All purchases within these product categories, regardless of the source of the product or the type of contract used to purchase them, should be included in your report. Include **all** product purchases — RCPs and non-RCPs.

1. Include **all** purchases (RCPs and non-RCPs) within the 11 product categories. RCPs outside of the 11 product categories **cannot** be counted toward attaining the procurement goals, and are not reportable.
2. Indicate the quantity (units) of **all** purchases (RCPs and non-RCPs) in each product category during the course of the project. Quantities do not need to be reported for the product categories with shading.
3. Indicate the total dollars spent on **all** purchases (RCPs and non-RCPs) in each product category purchased during the course of the project.
4. Indicate the total quantity (units) of RCPs purchased during the course of the project. Quantities do not need to be reported for the product categories with shading.
5. Indicate the total dollars spent on RCPs during the course of the project for each category.
6. Indicate the percentage of RCPs purchased. The percent recycled is calculated by dividing the figure in column 4 by the figure in column 2 and multiplying by 100. Percentages do not need to be calculated for the product categories with shading.
7. Indicate the percentage of total dollars spent on RCPs in each category. The percent recycled is calculated by dividing the figure in column 5 by the figure in column 3 and multiplying by 100.
8. The total of column 3 should be equivalent to the total estimated dollars spent on **all** products (RCPs and non-RCPs) during the course of the project.
9. The total of column 5 should be equivalent to the estimated total dollars spent on reportable RCPs during the course of the project.
10. Column 7 is calculated by dividing the figure in column 5 by the figure in column 3 and multiplying by 100.

PROJECT NAME: _____ PROJECT NO.: _____

State Agency Buy Recycled Campaign Procurement Summary

Attach copies of the recycled-content certification form(s) and/or other documentation for each product that contains any amount of recycled material.

CONTRACTOR'S / VENDOR'S NAME: _____ **DATE:** _____

ADDRESS: _____ **PROJECT DIRECTOR:** _____

PHONE: _____ **FAX:** _____

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Product Category[1]	**All Reportable Purchases (QUANTITY)[2]**	**All Reportable Purchases (DOLLARS)[3]**	**RCP Purchases (QUANTITY)[4]**	**RCP Purchases (DOLLARS)[5]**	**Percent of RCP (QUANTITY)[6]**	**Percent of RCP (DOLLARS)[7]**
Paper products		$		$		%
Printing and writing paper		$		$		%
Mulch, compost and cocompost	(cu yd)	$	(cu yd)	$	%	%
Glass products		$		$		%
Lubricating oils	(gal)	$	(gal)	$	%	%
Plastic products		$		$		%
Paint	(gal)	$	(gal)	$	%	%
Antifreeze	(gal)	$	(gal)	$	%	%
Tires		$		$	%	%
Tire-derived products		$		$		%
Metal		$		$		%
		Total[8]: $ _____		**Total[9]: $ _____**		**Total[10]: _____ %**

(See footnotes on the back of this page.)

Footnotes

Attach copies of the recycled-content certification worksheets and/or other documentation for each product.

Note: All purchases within these product categories, regardless of the source of the product or the type of contract used to purchase them, should be included in your report. Include **all** product purchases — RCPs and non-RCPs.

1. Include **all** purchases (RCPs and non-RCPs) within the 11 product categories. RCPs outside of the 11 product categories **cannot** be counted toward attaining the procurement goals, and are not reportable.
2. Indicate the quantity (units) of **all** purchases (RCPs and non-RCPs) in each product category during the course of the project. Quantities do not need to be reported for the product categories with shading.
3. Indicate the total dollars spent on **all** reportable purchases (RCPs and non-RCPs) in each product category purchased during the course of the project.
4. Indicate the total quantity (units) of reportable RCPs purchased during the course of the project. Quantities do not need to be reported for the product categories with shading.
5. Indicate the total dollars spent on reportable RCPs during the course of the project for each category.
6. Indicate the percentage of reportable RCPs purchased. The percent recycled is calculated by dividing the figure in column 4 by the figure in column 2 and multiplying by 100. Percentages do not need to be calculated for the product categories with shading.
7. Indicate the percentage of total dollars spent on reportable RCPs in each category. The percent recycled is calculated by dividing the figure in column 5 by the figure in column 3 and multiplying by 100.
8. The total of column 3 should be equivalent to the total estimated dollars spent on **all** reportable products (RCPs and non-RCPs) during the course of the project.
9. The total of column 5 should be equivalent to the estimated total dollars spent on reportable RCPs during the course of the project.
10. Column 7 is calculated by dividing the figure in column 5 by the figure in column 3 and multiplying by 100.

SECTION 01 74 23

CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Perform cleaning and disposal work as specified, complete. This Section forms a part of all other Sections of the specifications and shall be coordinated with such additional cleaning and disposal requirements as may be specified in other Sections.

1.02 RELATED REQUIREMENTS

A. Document 00 72 00: General Conditions of the Contract for Construction; Paragraph 3.16, Cleaning Up.

B Section 01 74 19: Construction Waste Management.

C. Pertinent Specification Sections: Specific requirements for cleaning.

1.03 CLEANING IN GENERAL

A. Contractor shall at all times keep premises free from accumulations of waste material or rubbish caused by Contractor’s employees or work, or employees or work of subcontractors, and shall remove rubbish from and about areas of Work and Contractor’s and subcontractors' tools, scaffolding and surplus materials and shall leave the Work "broom clean", or its equivalent, except as hereinafter specified. In case of dispute between Contractor and other contractors employed on or about the work areas, as to responsibility for removal of rubbish, etc., or in case debris is not promptly removed as herein required, the State may remove rubbish, etc., and backcharge the Contractor.

B. At all times, Project working area and site shall be kept clean and orderly. Dirt, debris, waste, rubbish and disused implements and equipment shall be removed frequently and not allowed to accumulate more than 24 hours. Flammable and toxic materials shall not be stored in structures.

1.04 FINAL CLEANING

A. Within Contract limits, clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

1. Clean equipment and fixtures to sanitary condition, clean or replace filters of mechanical equipment.

2. Clean roofs, gutters, downspouts and drainage systems.

3. Glass: Clean all glass, interior and exterior, affected by Work of this Project; including removal of foreign material from glass.

B. Clean site: Sweep paved areas, rake clean other surfaces.

C. Remove waste and surplus materials, rubbish and construction facilities from Project and from site.

D. Dust, dirt, stains, hand marks, paint spots, and like defects shall be completely removed from surfaces. Metal surfaces shall be cleaned, using only non-corrosive and non-abrasive materials.

E. Final Inspection: Deficient cleaning operations, as determined by the State, shall be immediately corrected as directed.

1.05 DISPOSAL

A. Under no circumstances shall rubbish or waste material be disposed of in site fills or backfills. Debris, rubbish, and waste or surplus material shall be removed from the State property daily and legally disposed of.

END OF SECTION

SECTION 01 75 00

STARTING AND ADJUSTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for starting of systems, including the following:

1. Heating, Ventilating, and Air Conditioning

2. Detection and Alarm.

1.02 RELATED SECTIONS

A. Section 01 33 00: Submittal Procedures.

B. Section 01 79 00: Demonstration and Training.

C. Section 23 05 93H: Testing, Adjusting, and Balancing for HVAC

D. Section 28 31 00: Fire Alarm Systems

E. Section 23 74 13H: Packaged Outdoor Central-Station Air-Handling Units

1.03 QUALITY CONTROL

A. When so specified in individual Sections, require manufacturer to provide authorized representative to be present at Project site to inspect, check, and approve equipment installation prior to start-up; to supervise placing of equipment in operation; and to provide written report that equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting lines or anchor bolts, and has been satisfactorily operated under full load conditions.

1.04 SUBMITTALS

A. Sequencing Schedule: Submit preliminary schedule listing times and dates for start-up of each item of equipment, in sequence, two weeks prior to proposed dates. Approved Schedule shall be the sequencing schedule.

B. Reports: Submit manufacturer representative's reports within one week after start-up, listing start-up dates.

1.05 PROJECT CONDITIONS

A. Ensure building is enclosed and weathertight.

B. Ensure excess packing and shipping bolts are removed.

C. Ensure interdependent systems have been checked and are operational.

1.06 INSPECTION

A. Verify that Project conditions comply with specified and manufacturer’s requirements.

B. Verify that status of work meets requirements for start-up of equipment and systems.

1.07 PREPARATION

A. Coordinate sequence of start-up for various items of equipment.

B. Notify the State Inspector 7 days prior to start-up of each item of equipment.

C. Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during entire start-up process.

D. Verify that each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence and other conditions which may cause damage.

E. Verify control systems are fully operational in automatic mode.

F. Verify that tests, meter readings, and specific electrical characteristics agree with those specified by electrical equipment manufacturer.

G. Verify wiring to motors and controls, required by mechanical work for operational smoke and fire protection demonstrations, is complete.

H. Bearings: Inspect for cleanliness; clean and remove foreign matter. Verify alignment and take corrective measures, if required.

I. Drives: Inspect for tension on belt drives, adjustment of varipitch sheaves and drives, alignment, proper equipment speed and cleanliness. Take corrective measures, if required.

J. Motors: Verify that motor amperage agrees with nameplate value. Inspect for conditions which produce excessive current flow and which exist due to equipment malfunction. Take corrective measures, if required.

1.08 STARTING SYSTEMS

A. Execute start-up under supervision of Contractor's personnel; or manufacturer’s representative when so specified.

B. Place equipment for operation in proper sequence, in accordance with approved sequencing schedule.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Closeout Procedures.

B. Project Record Documents.

C. Operation and Maintenance Data.

D. Guaranties, Warranties and Bonds.

E. Spare Parts and Maintenance Materials.

F. Certification of Recycled Content.

G. Waste Management Report.

H. Certification of Small Business/Disabled Veteran Business Enterprise Participation

1.02 RELATED REQUIREMENTS

A. Documents 00 72 00 and 00 73 00: General Conditions of the Contract for Construction, and Supplementary Conditions: Fiscal provisions, legal submittals and other administrative requirements.

B. Section 01 11 00: Summary.

C. Section 01 32 33: Construction Photographs; submittal of digital files and video with Project Record Documents.

D. Section 01 33 00: Submittal Procedures.

E. Section 01 51 00: Temporary Facilities and Controls.

F. Section 01 74 19: Construction Waste Management and Appendix 01 74 19.2, Waste Management Report.

G. Section 01 74 20: Recycled Content Certification.

H. Section 01 74 23: Cleaning.

1.03 CLOSEOUT PROCEDURES

A. Comply with procedures stated in General Conditions of the Contract for Construction, Document 00 72 00, Article 8, for final inspection, Completion of the Work and Acceptance of the Work, payment and retention procedures.

B. Contractor shall start developing and completing punch list items a minimum of 30 calendar days prior to the end of the Contract Time as specified in Section 01 32 16, Article 1.03.

C. When Contractor considers the Work complete, the Contractor shall request, in writing, a final inspection to be conducted by the State. The State Representative shall conduct a final inspection within 14 days of receipt of the written request. Prior to requesting a final inspection, the Contractor shall have the entire Work completed in accordance with all Contract Requirements, including, but not limited to, all punch list items, and submittal of all documents and products listed in this section and other sections of the Project Manual. It is recommended that the Contractor request the final inspection as early as possible, and prior to the end of Contract Time, to allow for completion of punch list items discovered to be incomplete during the final inspection and for a final re-inspection, to avoid assessment of liquidated damages.

D. The date of Completion of the Work and Acceptance of the Work will be determined as specified in Document 00 72 00, Article 8.6.

E. Final cleaning shall be completed prior to occupancy or requesting a final inspection, whichever comes first. Refer to Section 01 74 23, Cleaning.

1.04 PROJECT RECORD DOCUMENTS ("AS-BUILTS")

A. Maintain, on current basis, record drawings showing "as-built" conditions of project; subject to monthly review by State Inspector. The State will furnish reproducible prints to Contractor, who shall transfer installed locations to reproducible prints and submit prints for review by the State. Monthly pay estimates will not be processed without review and approval of record drawings by State Inspector. Final inspection will not be scheduled until reproducible record drawings are turned over to State Inspector.

B. Store Project record documents separate from those used for construction.

C. At time of installation, installed locations of work relating to aboveground and underground utilities, architectural, structural, heating, ventilation, air conditioning, plumbing, electrical, and other scopes of work as may be required, shall be recorded on prints by Contractor, and reviewed with State Inspector. Do not conceal work until required information is recorded.

1. Information entered on reproducible prints shall be neat, legible, and emphasized by drawing "balloons" around changed items.

2. Symbols and designations used in preparing record drawings shall match those used in Contract Drawings.

3. Locate and dimension work, including stubs for future connections, with reference to permanent landmarks or buildings and indicate approximate depth below finish grade.

D. Prior to requesting a final inspection, submit Project record documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents and signature of Contractor.

1.05 OPERATION AND MAINTENANCE DATA

A. Provide data for Sections as required by the Contract Documents; including:

1. Mechanical Equipment and Controls - Division 23.

2. Electrical Equipment and Controls - Division 26.

B. Submit 5 sets of operating/maintenance manuals prior to requesting a final inspection, bound in 8-1/2 x 11 inch three ringside binders with durable plastic covers; with identification on, or readable through, front cover stating general nature of manual.

C. Provide separate volume for each system, with table of contents and index tabs for each volume; all material neatly typewritten; each volume containing:

1. Part 1: Directory, listing names, addresses and telephone numbers of Project Director, State Inspector and Contractor; and index furnishing complete information as to location in manual of emergency data regarding installation.

2. Part 2: Operation and maintenance instructions, arranged by system. For each system, give names, addresses and telephone numbers of subcontractors and suppliers; and include the following:
   a. Appropriate design criteria.
   b. List of equipment.
   c. Parts list; including complete nomenclature, current costs, and names and address of nearest vendor of parts.
   d. Detailed operating instructions.
   e. Maintenance instructions, equipment, including routine maintenance cards with time frequency of routine maintenance noted.
   f. Maintenance instructions, finishes.
   g. Shop drawings and product data, including changes made during construction.
   h. Copies of Guaranties/Warranties.

D. Extraneous Data: Where contents of manuals include manufacturers' catalog pages, clearly indicate precise items included in this installation and delete, or otherwise clearly indicate, manufacturer's data with which this installation is not concerned.

E. Final inspection will not be scheduled until operation/maintenance manuals are delivered to the State Inspector.

1.06 GUARANTIES, WARRANTIES AND BONDS

A. Standard Guaranty: Guarantee Work executed under this Contract to be free of defects of workmanship and materials for a period of one year after the date of Completion of the Work. Refer to General Conditions of the Contract for Construction, Document 00 72 00, Article 3.5. Submittal is not required for standard one year guaranty for Work of this project.

B. Additional Guaranties/Warranties: Provide additional guaranties/warranties (in excess of one year) where specifically required by pertinent Specification Sections. The start date of the Guaranty will commence on the date of Completion of the Work as established by the State Representative.

1. Provide duplicate, notarized copies. Execute Contractor's submittals and assemble documents executed by subcontractors, suppliers and manufacturers. Provide table of contents and assemble in binder with durable plastic cover.

2. Submit guaranties/warranties prior to requesting a final inspection.

C. For equipment put into use with State's permission during construction, submit guaranties/warranties within 10 days after first operation.

D. This Project does not includes separate buildings. The Guarantee will commence as specified in Document 00 72 00, Article 8.5.2.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each Section, in addition to that used for construction of work. Coordinate with State Inspector; deliver to Project site, and obtain a receipt.

1.08 CERTIFICATION OF RECYCLED CONTENT

A. Refer to General Conditions of the Contract for Construction, Document 00 72 00, Article 3.21, Certification by Contractor of Recycled Content and to Section 01 74 20, Recycled Content Certification, for final submittal of the State Agency Buy Recycled Campaign (SABRC) Procurement Report.

B. Final Submittal: Upon completion of all construction submittals, and prior to requesting a final inspection, submit the form provided by the State. The summary shall show totals for all purchases of material, goods, or supplies offered or products used in the performance of Work of this Contract; that are from one of the eleven (11) product categories defined in Section 01 74 20. Attach supporting documentation for materials, goods, supplies, or products that contain any amount of recycled materials.

C. Final inspection will not be scheduled until the completed final SABRC Procurement Summary with supporting documentation is submitted by Contractor and received by the State.

1.09 WASTE MANAGEMENT REPORT

A. Upon completion of Work, and prior to requesting a final inspection, submit an itemized Waste Management Report summarizing the waste generated, sent to landfill, reused, and recycled which is attributed to Work of this Project.

B. Refer to Section 01 74 19, Construction Waste Management, and Appendix 01 74 19.2, Waste Management Report.

C. Final inspection will not be scheduled until completed Waste Management Report is submitted by Contractor and received by the State.

1.10 CONTRACTOR'S CERTIFICATION OF DISABLED VETERAN BUSINESS ENTERPRISE (DVBE) PARTICIPATION

A. Upon Completion of the Work, together with a Final Payment Application, the Contractor shall submit complete and accurate Form STD 817 “Prime Contractor’s Certification – DVBE Subcontracting Report”. The State shall review the Form STD 817, and if it is determined to be complete and accurate, the payment will be authorized.

B. If the Form STD 817 is late or determined to be incomplete or inaccurate, the State shall withhold ten thousand dollars ($10,000) from the final payment, or the full final payment if less than ten thousand dollars ($10,000), and provide the Contractor with a notice allowing at least 15 days, but not more than 30 days to cure the defect.

1. If the Contractor does not comply by the deadline identified in the Cure Notice, the State shall permanently deduct the ten thousand dollars ($10,000) from the final payment, or the full final payment if less than ten thousand dollars ($10,000).

1.11 CONTRACTOR'S CERTIFICATION OF SMALL BUSINESS (SB) PARTICIPATION

A. If final payment has been made to Small Business, upon Completion of the Work, Contractor shall submit the two-page certification, "Contractor's Certification of SB Participation" located in Section 01 77 00, Appendix A.

B. If retention has been withheld and final payment to Small Business subcontractors will not be made until the Contractor has received Final Payment from the State, Contractor shall: 1. upon completion of the Work submit the two-page certification, "Contractor's Certification of SB Participation" located in Section 01 77 00, Appendix A; and mark the box entitled "PRELIMINARY REPORT" 2. within 30 days of receipt of Final Payment submit an updated report and mark the box entitled "FINAL REPORT".

C. When completing the Certification, the Contractor shall include all Small Business even if the firms were not listed at bid time when completing percentage calculations. If SB utilization was different than that approved in original agreement, provide comments. The second page of the Certification may be copied as needed to list all firms.

END OF SECTION

State of California
Department of General Services - Procurement Division
Prime Contractor's Certification - DVBE Subcontractor Report
STD 817, Formerly DGS PD 810P

STATE DEPARTMENT AND CONTRACT INFORMATION

State Department Information		Contract Information		Prime Contractor Information:		FOR STATE USE ONLY	
State Department Name:		Contract #:		Name:		Date Received:	
State Department Address:		FI$Cal Supplier ID#:		Address:			
Contract Manager Name:		Contract Execution Date:		Phone #:			
Contract Manager Phone #:		Date Work Completed:		Email:			
Contract Manager Email Address:		Contract Award Amount:		Date Last Payment Received:			
				Contract Received Amount:			

SECTION 3 — **List all Disabled Veteran Business Enterprise firms involved with this contract.**

	(A) DVBE Subcontractor(s) Name	(B) DVBE Subcontractor(s) Address	(C) DVBE Certification ID Number	(D) Total Contract Commitment Percentage to DVBE	(E) Total Contract Commitment Amount to DVBE	(F) Total Payment Amount to DVBE	(G) Difference in Amount Paid to DVBE (F - E)	(H) Percentage Paid to DVBE (F/Contract Received Amount)
	Number of DVBE Subcontractors		**Grand Total**		$ 0.00	$ 0.00	$ 0.00	0.00%
1.				0.00%			0.00	0.00%
2.				0.00%			0.00	0.00%
3.				0.00%			0.00	0.00%
4.				0.00%			0.00	0.00%
5.				0.00%			0.00	0.00%
6.				0.00%			0.00	0.00%
7.				0.00%			0.00	0.00%
8.				0.00%			0.00	0.00%
9.				0.00%			0.00	0.00%
10.				0.00%			0.00	0.00%
11.				0.00%			0.00	0.00%
12.				0.00%			0.00	0.00%
13.				0.00%			0.00	0.00%

	(I) Comments/Explanations	

Use next page for additional lines

I certify under penalty of perjury under the laws of the State of California that all information submitted is true and correct.

Prime Contractor	Print Name:		Date:	
	Title:			
	Signature:			

Return upon completion of contract.

Americans with Disabilities (ADA) Notice: Persons with disabilities requiring reasonable modifications should contact the OSDS Report Coordinator at OSDSReports@dgs.ca.gov

State of California
Department of General Services - Procurement Division
Prime Contractor's Certification - DVBE Subcontractor Report
STD 817, Formerly DGS PD 810P

STATE DEPARTMENT AND CONTRACT INFORMATION

State Department Information		Contract Information		Prime Contractor Information		FOR STATE USE ONLY	
State Department Name:		Contract #:		Name:		Date Received:	
State Department Address:		FI$Cal Supplier ID#:		Address :			
Contract Manager Name:		Contract Execution Date:		Phone #:			
Contract Manager Phone #:		Date Work Completed:		Email:			
Contract Manager Email Address:		Contract Award Amount:		Date Last Payment Received:			
				Contract Received Amount:			

List all Disabled Veteran Business Enterprise firms involved with this contract.

	(A) DVBE Subcontractor(s) Name	(B) DVBE Subcontractor(s) Address	(C) DVBE Certification ID Number	(D) Total Contract Commitment Percentage to DVBE	(E) Total Contract Commitment Amount to DVBE	(F) Total Payment Amount to DVBE	(G) Difference in Amount Paid to DVBE (F - E)	(H) Percentage Paid to DVBE (F/Contract Received Amount)
Number of DVBE Subcontractors			**Total**		$ 0.00	$ 0.00	$ 0.00	0.00%
14.				0.00%			0.00	0.00%
15.				0.00%			0.00	0.00%
16.				0.00%			0.00	0.00%
17.				0.00%			0.00	0.00%
18.				0.00%			0.00	0.00%
19.				0.00%			0.00	0.00%
20.				0.00%			0.00	0.00%
21.				0.00%			0.00	0.00%
22.				0.00%			0.00	0.00%
23.				0.00%			0.00	0.00%
24.				0.00%			0.00	0.00%
25.				0.00%			0.00	0.00%
26.				0.00%			0.00	0.00%
27.				0.00%			0.00	0.00%
28.				0.00%			0.00	0.00%
29.				0.00%			0.00	0.00%
30.				0.00%			0.00	0.00%
31.				0.00%			0.00	0.00%
32.				0.00%			0.00	0.00%
33.				0.00%			0.00	0.00%
34.				0.00%			0.00	0.00%
35.				0.00%			0.00	0.00%
36.				0.00%			0.00	0.00%

Attach copies of this page for additional lines

I certify under penalty of perjury under the laws of the State of California that all information submitted is true and correct.

Americans with Disabilities (ADA) Notice: Persons with disabilities requiring reasonable modifications should contact the OSDS Report Coordinator at OSDSReports@dgs.ca.gov

Form Completion Instructions

GENERAL INFORMATION: Military and Veteran Code (MVC) 999.5(d), 999.7 and Government Code (GC) 14841, and California Code of Regulations (CCR) 1896.78(e) requires all Prime Contractors that committed to have a Disabled Veteran Business Enterprise (DVBE) perform an element of work for a contract to report DVBE subcontractor participation information and certify to the state that all DVBE subcontracting payments were made. Departments are required to withhold $10,000 from the final payment, or the full payment if less than $10,000, on contracts until the Prime Contractor complies with the certification requirements by submitting this form.

If prime contractors do not comply with the requirements after given notice to cure by the state departments, the withheld amount will be permanently deducted.

All contracted work must be completed before submission of invoice(s) and this certification form.

Prime Contractors are required to maintain records supporting the information submitted on this form and that all payments to DVBE subcontractor(s) were made. Upon request, proof of payment must be provided (MVC 999.5(d)).

INCLUDE

- **ONLY ONE contract per Report**
- **All DVBEs that performed an element of work for this contract regardless of tier**

State Department Information:

State Department Name: Enter the State Department name

State Department Address: Enter the State Department address

Contract Manager Name: Enter the Contract Manager name

Contract Manager Phone Number: Enter the Contract Manager phone #

Contract Manager Email Address: Enter the Contract Manager email address

Contract Information

Contract Number: Enter the Contract Number

Contractor's FI$Cal Supplier ID Number: Enter your FI$Cal supplier ID number

Contract Execution Date: Enter the date contract was signed

Date Work Completed: Enter the date the work was completed on the contract

Contract Award Amount: Enter the total dollar amount awarded for this contract including all financial amendments

State of California
Department of General Services Procurement Division
Prime Contractor's Certification - DVBE Subcontracting
Report STD 817, Formerly DGS PD 810P
(Rev. 10/2021)

Form Completion Instructions

Prime Contractor Information:

Prime Contractor Name: Enter your name as shown on the contract

Prime Contractor Address: Enter your address

Phone Number: Enter your number (with area code)

Email Address: Enter your email address

Date Last Payment Received: Enter the date the last payment for work performed was received

Contract Received Amount: Enter the dollar amount of the last payment received

For State Use Only

Date STD 817 Received: Enter date the Contract Manager received the STD 817 from the Prime Contractor

TABLE INSTRUCTIONS

A) DVBE Subcontractor(s) Name: Enter the name of all DVBEs that are listed to perform an element of work or supplies for this contract and any formal approved substitution(s). (Use additional lines if the name does not fit on a single line) Use page two for additional lines.

B) DVBE Subcontractor(s) Address: Enter the address of each DVBE (Use page 2 for additional lines if address does not fit on a single line)

C) DVBE Certification ID Number: Enter each DVBE's certification number

D) Total Contract Commitment Percentage to DVBE: Enter the total percentage of contracted dollars to each DVBE at the time of award

E) Total Contract Commitment Amount to DVBE: Enter the entire amount contracted to each DVBE at the time of award

F) Total Payment Amount to DVBE: Enter the total amount paid to all DVBEs that performed an element of work or were suppliers for this contract

Form Completion Instructions

Note: Complete and accurate certifications are due upon completion of contract.

G) **Difference in Amount Paid to DVBE**: The form will compute the difference of DVBE dollars contracted compared to dollars paid

H) **Percentage Paid to DVBE:** The form will compute the percentage paid to DVBEs using the Contract Received Amount entered under State and Contract Information

Instructions I

I) **Comments/Explanations:** Enter any relevant comments and explanations for any differences between the DVBE amounts or percentages committed and paid. Reference the line number if comments and explanations are used.

SIGNATURE BLOCK

Prime Contractor's Signature: Enter your printed name, title, sign with an electronic signature or a wet signature, and date

CONTRACTOR'S CERTIFICATION OF SB PARTICIPATION

TO:	Real Estate Services Division (Construction Services Area Office Address)	Date: Project Number: Contract Number:

FROM:

PROJECT TITLE:

THIS IS TO CERTIFY THAT I, _____
(Print Name)

AS AN AUTHORIZED OFFICIAL OF _____
(Firm or Corporation)

WORKING IN THE CAPACITY OF _____
(Title)

AND HAVE BEEN PROPERLY AUTHORIZED BY SAID FIRM OR CORPORATION TO SIGN THE FOLLOWING STATEMENT PERTAINING TO SUBJECT CONTRACT.

Pursuant to Section 14841 of the Government Code,

I, the undersigned, hereby certify that to the best of my knowledge, the Small Business participation information listed on the attached report for the above contract is complete and correct.

SIGNED: DATE:

State of California · Department of General Services

☐ **PRELIMINARY REPORT**

CONTRACTOR'S CERTIFICATION OF SB PARTICIPATION

☐ **FINAL REPORT**

CONTRACT NUMBER	PROJECT NUMBER	CONTRACT COMPLETION DATE	CONTRACT ACCEPTANCE DATE

PRIME CONTRACTOR	ORIGINAL CONTRACT AMOUNT	FINAL CONTRACT AMOUNT

DESCRIPTION OF WORK PERFORMED AND MATERIALS PROVIDED	SB BUSINESS NAME AND ADDRESS	SB CERT. NO.	SB CONTRACT PAYMENTS			
			PAYMENT AMOUNT	DATE WORK COMPLETED	DATE OF FINAL PAYMENT	COMMENTS
		TOTAL $				

ORIGINAL SMALL BUSINESS COMMITMENT: _____%

ACTUAL SMALL BUSINESS ACHIEVED: _____%

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for demonstration of equipment and systems operation and instruction of up to 15 State personnel.

1.02 RELATED SECTIONS

A. Section 01 11 00 - Summary: Work sequencing.

B. Section 01 32 16: Progress Schedule and Reports.

C. Section 01 75 00: Starting and Adjusting.

D. Section 01 77 00 - Closeout Procedures: Operation and maintenance data.

E. Section 23 05 93H: Testing, Adjusting, and Balancing for HVAC

G. Individual Sections: Specific requirements for demonstrating equipment and systems.

1.03 QUALITY ASSURANCE

A. When so specified in individual Sections, provide demonstration and instruction to State personnel, performed by a representative approved by the equipment or system manufacturer.

B. Demonstration and instruction shall be specific to each type of equipment or system supplied by the manufacturer. At a minimum, demonstration and instruction shall include: operational theory; maintenance; trouble shooting/repair; and calibration.

C. State will provide list of personnel to receive instructions and will coordinate their attendance at agreed upon times.

1.04 SUBMITTALS

A. Submit preliminary schedule for State's approval, listing times and dates for demonstration and instruction of each item of equipment and each system, 3 weeks prior to proposed dates.

B. Submit proposed training materials and a detailed outline of each demonstration and instruction at least 30 days in advance of training.

C. Submit reports within one week after completion of demonstrations indicating that demonstrations and instructions have been satisfactorily completed. List time and date of each demonstration and hours devoted to demonstration and instruction, and list names of persons present.

D. Submit digital CD/DVD recording with audio of demonstrations and instructions with each report.

1.05 PREPARATION

A. Verify equipment and systems have been inspected and put into operation in accordance with Section 01 75 00; testing, adjusting and balancing has been performed in accordance with Section 01 79 00, and equipment and systems are fully operational.

B. Furnish training materials, books, etc. to each student attending the training classes and have copies of completed operation and maintenance manuals at hand for use in demonstrations and instructions.

1.06 DEMONSTRATION AND INSTRUCTIONS

A. Prior to acceptance of equipment or systems, demonstrate operation and maintenance of equipment and systems to State's personnel as scheduled.

B. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance and shutdown of each item of equipment or system at agreed upon times, at equipment or system location.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

F. All demonstrations and training described in this section and all other sections shall take place and be completed prior to the Contractor requesting a final inspection.

1.07 TIME ALLOCATED FOR INSTRUCTIONS

A. Amount of time required for instruction on each item of equipment and system shall be as specified in individual Sections.

1. Section 23 74 13H - Packaged Outdoor Central-Station Air Handling Units
2. Section 23 84 13H - Humidifiers
3. Section 27 41 00 – Audio/Video Systems

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Demolition and removal of selected portions of existing buildings or structures.
   2. Salvaging existing items for reinstallation or delivery to Owner.

B. Related Sections include:
   1. Division 1 Section for temporary construction, protection facilities, and environmental-protection measures for selective demolition operations.
   2. Division 1 Section for cutting and patching procedures.
   3. Division 1 Section for construction waste management and administrative and procedural requirements for salvaging and recycling of demolition waste.
   4. Division 1 Section for photographic documentation of existing buildings and sitework prior to selective demolition.
   5. Division 22 Sections for demolishing or relocating plumbing items.
   6. Division 23 Sections for demolishing or relocating mechanical items.
   7. Division 26 Sections for demolishing or relocating electrical items.

1.3 REFERENCES

A. American National Standards Institute (ANSI)/American Society of Safety Engineers (ASSE):
   1. ANSI/ASSE A10.6: Safety Requirements for Demolition Operations.

B. Cal/OSHA Standards - California Code of Regulations, Title 8, Chapter 4, Division of Industrial Safety.

C. Code of Federal Regulations (CFR):
   1. 40 CFR, Part 82: Protection of Stratospheric Ozone.

D. EPA: United States Environmental Protection Agency.

E. National Fire Protection Association (NFPA):
   1. NFPA 51B: Standard for Fire Prevention During Welding, Cutting, and Other Hot Work.
   2. NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations.

F. Resilient Floor Covering Institute (RFCI):

1. Recommended Work Practices for Removal of Resilient Floor Coverings.

1.4 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are to be undisturbed and left in place.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.5 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner’s on-site operations.

1.7 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review and finalize protection requirements for areas of existing construction to remain.
6. Review procedures for noise control and dust control.
7. Review procedures for protection of adjacent buildings.
8. Review items to be salvaged and returned to Owner.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Coordinate to avoid interruptions to Owner's on-site operations.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Shutoff and capping, and continuation of utility services.
4. Locations of temporary protection of means of egress, including for other tenants affected by selective demolition operations, if applicable.
5. Coordination of Owner's continuing occupancy of portions of existing buildings and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. ***[Comply with Division 1 Section for photographic documentation.]*** Submit prior to beginning Work.

F. Record drawings of removed, relocated, or abandoned utilities in accordance Division 1 Section for project closeout requirements.

1. Locate and dimension work with reference to permanent landmarks. Indicate materials and sizes of all components.

G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

H. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demoltion.

1.9 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.10 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.11 FIELD CONDITIONS

A. Owner will occupy portions of the building immediately adjacent to selective demolition areas. Conduct selective demolition so Owner's operations will not be disrupted.

1. Provide not less than ***[10]*** working days notice to Owner of activities that will affect Owner's operations.
2. Maintain access to existing walkways, exits, and other adjacent occupied or used facilities.

B. Owner assumes no responsibility for buildings and structures to be demolished.

1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practical. Minor variations may occur as a result of Owner's salvaging operations prior to start of selective demolition work.

a. Before start of demolition, Owner will remove the following items:

i) ***[insert items to be removed by Owner]***

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

F. On-site storage or sale of removed items or materials is not permitted.

G. Utility Service: Maintain existing utilities serving building and protect them against damage during selective demolition operations, unless indicated otherwise.

1. Do not interrupt fire-protection service during selective demolition operations.

1.12 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. ***[insert list of existing warranties occurring on project, e.g. roof warranties, etc.]***

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are the same as those indicated in Project Record Documents.

C. Determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations. If required, engage a professional engineer to perform an engineering survey of condition of building.

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

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Survey of Existing Conditions: Record by use of preconstruction photographs or video, existing conditions that might be misconstrued as damage caused by demolition operations. ***[Comply with requirements of Division 1 Section for photographic documentation.]***

1. Inventory and record the condition of items to be removed and salvaged.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Utilities to be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.

[or]

2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
5. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
6. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
    1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
    2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
    3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
    4. Cover and protect furniture, furnishings, and equipment that have not been removed.
    5. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate fumes and noise from selective demolition areas from occupied adjacent portions of building. Comply with Division 1 requirements for temporary facilities.

B. Temporary Shoring: Design, provide and maintain shoring, bracing, or structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
    1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Do not damage portions of existing construction indicated to remain. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
    a. Remove below-grade construction footings, to depths indicated.
5. If using cutting torches, comply with applicable requirements of Cal/OSHA Standards (California Code of Regulations, Title 8), Chapter 4 - Division of Industrial Safety, Subchapter 7 – General Industry Safety Orders, Article 88 Fire Prevention in Welding and Cutting Operations, and NFPA 51B.
    a. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
    b. Maintain fire watch during and for at least 1 hour after flame-cutting operations.
    c. Maintain adequate ventilation when using cutting torch
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Equipment: Disconnect equipment indicated to be removed at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
8. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
    a. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. ***[Comply with requirements in Division 1 Section for construction waste management and disposal.]***

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Items to be removed and salvaged are indicated on Drawings

2. Comply with the following:
    a. Clean salvaged items of dirt and demolition debris.
    b. Remove premanufactured building components as whole units, intact and undamaged.
    c. Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole unit, complete with controls.
    d. Pack or crate items after cleaning. Identify contents of containers.
    e. Store items in a secure area until delivery to Owner.
    f. Transport items to storage area designated by Owner.
    g. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of container.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

D. Roofing: Remove not more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 7 Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roof system down to substrate.

3.7 REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction. ***[Refer to Division 1 Section for construction waste management for additional requirements for salvaging and recycling demolition waste materials.]***

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.9 CLEANING

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

END OF SECTION 02 41 19

SECTION 03 05 05

CONCRETE SEALER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Clear sealing compound for exposed concrete surfaces.

B. Related Sections include:
   1. Section 03 31 00 0"Cast-In-Place Concrete" for concrete slabs to receive clear sealer.

1.3 REFERENCES

A. ASTM International (American Society for Testing and Materials).
   1. ASTM C 309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   2. ASTM C 1315: Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

B. California Department of Health Services:
   1. Standard Practice for the Testing of Volatile Organic Emissions from Various Sources using Small-Scale Environmental Chambers (including 2004 Addenda).

C. Code of Federal Regulations (CFR):
   1. 40 CFR, Part 59, Subpart D: National Volatile Organic Compound Emission Standards.

D. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1113 – Architectural Coatings.

1.4 DEFINITIONS

A. VOC: Volatile organic compounds.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   1. Include manufacturer's printed statement of VOC content.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer of concrete sealer.

B. Regulatory Requirements: Conform to regulations of California Air Resources Board and local air quality/air pollution control district regarding VOC content.

C. Mockup: Apply concrete sealer to 36-inch by 36-inch area as directed by Architect to demonstrate aesthetic effects and qualities of materials and execution.

1. Obtain Architect's approval of mockups before starting application.
2. Maintain mockup area in an undisturbed condition during construction as a standard for judging completed Work.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Comply with concrete sealer manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting application of concrete sealer.

B. Take precautions as needed to prevent staining of or damage to concrete surfaces prior to application of concrete hardening compound.

PART 2 - PRODUCTS

2.1 CONCRETE SEALER

A. Clear, Waterborne, Membrane-Forming Sealing Compound: Nondissipating; ASTM C 309, Type 1, Class B; ASTM C 1315, Type 1, Class A (nonyellowing).

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ChemMasters; Polyseal WB.
   b. Conspec Marketing & Manufacturing Company; Sealcure #1315 WB.
   c. Euclid Chemical Company; Super Diamond Clear VOX.
   d. Meadows, W.R., Inc.; Vocomp-25.
   e. Equal product in accordance with Division 1 requirements for product substitutions.
2. VOC Content: Provide concrete sealer that complies with local regulatory limits for VOC content when calculated according to 40 CFR, Part 59, Subpart D (EPA Method 24).
   a. In addition to local regulatory limits, comply with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule #1113 for floor coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to concrete sealer manufacturer's requirements.

B. Proceed with installation/application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of substances that might interfere with performance of sealing compound. Test for moisture content, according to manufacturer's written instructions, to ensure that surface is dry enough.

1. Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of sealing compound.

B. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of sealing compound. Cover adjoining and nearby surfaces if there is a possibility of sealing compound being deposited on surfaces.

C. Coordination with Sealants: Do not apply sealing compound until sealants for joints adjacent to surfaces receiving sealer have been installed and cured.

1. Concrete sealer application may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, sealing compound, and sealant materials identical to those used in the work.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect substrate before application of sealing compound and to instruct Applicator on the product and application method to be used.

B. Apply coating of sealing compound in a continuous film, using low-pressure spray equipment. Comply with manufacturer's written instructions for application.

3.4 CLEANING AND PROTECTION

A. Immediately clean sealing compound from adjoining surfaces and surfaces soiled or damaged by concrete sealer application as work progresses. Repair damage caused by concrete sealer application. Comply with manufacturer's written cleaning instructions.

B. Protect concrete surfaces treated with sealer during remainder of construction period to ensure that surfaces are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 03 05 05

SECTION 051200

STRUCTURAL STEEL FRAMING

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. Structural steel.
2. Grout.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.04 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

B. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 358.
4. AISC 360.
5. RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
6. AWS D1.1/D1.1M.
7. AWS D1.8/D1.8M.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's Testing Agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.08 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles, M-, S-Shapes: ASTM A 36/A 36M

C. Plates and Bars: ASTM A 572/A 572M, Grade 50, typical.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.

1. Finish: Black

E. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 3125, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

C. Headed Anchor Rods: ASTM F 1554, Grade 36, typical; ASTM F 1554; straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

D. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened carbon steel.
3. Finish: Plain.

2.03 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.

2.04 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug-Tightened (ST) unless noted otherwise on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Top flange of beams supporting steel decking.
4. Surfaces to be high-strength bolted with slip-critical connections.
5. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
6. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Determine, furnish and install all temporary supports, such as temporary guys, beams, braces, falsework, cribbing or other elements required for the erection operation. These temporary supports shall be sufficient to secure the bare structural steel framing or any portion thereof against loads that are likely to be encountered during erection, including those due to wind and those that result from erection operations. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug-tightened unless noted otherwise on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified independent Testing Agency to inspect field welds and high-strength bolted connections and prepare test reports.

B. Inspections: Verify and inspect structural steel Work as shown on Drawings.

C. Bolted Connections: Bolted connections will be tested and inspected according to RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at Testing Agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Steel framing and supports for countertops.
   2. Steel framing and supports for overhead coiling doors.
   3. Steel framing and supports for mechanical and electrical equipment.

B. Products furnished, but not installed, under this Section include:
   a. Loose steel lintels.
   b. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   c. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections include:
   1. Section 09 91 00 “Painting” for field painting of metal fabrications.

1.3 REFERENCES

A. Aluminum Association (AA).

B. American Architectural Manufacturers Association (AAMA):
   1. AAMA 611: Voluntary Specification for Anodized Architectural Aluminum.

C. American Concrete Institute (ACI):
   1. ACI 318: Building Code Requirements for Structural Concrete.

D. American National Standards Institute (ANSI):
   1. ANSI A14.3: American National Standard for Ladders – Fixed – Safety Requirements.

E. American Society of Mechanical Engineers (ASME):
   1. ASME A17.1: Safety Code for Elevators and Escalators.
   2. ASME B18.2.1: Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.
   3. ASME B18.6.1: Wood Screws.
   4. ASME B18.6.3: Machine Screws, Tapping Screws, and Metallic Drive Screws.
   5. ASME B18.21.1: Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers.

6. ASME B18.22.1: Plain Washers.

F. American Welding Society (AWS):
1. AWS D1.1: Structural Welding Code - Steel.
2. AWS D1.2: Structural Welding Code – Aluminum.
3. AWS D1.6: Structural Welding Code – Stainless Steel.

G. ASTM International:
1. ASTM A36: Standard Specification for Carbon Structural Steel.
2. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123: Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
4. ASTM A 153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
6. ASTM A276: Standard Specification for Stainless Steel Bars and Shapes.
7. ASTM A283: Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
8. ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
9. ASTM A312: Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
10. ASTM A413: Standard Specification for Carbon Steel Chain.
11. ASTM A480: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
12. ASTM A489: Standard Specification for Carbon Steel Eyebolts.
13. ASTM A492: Standard Specification for Stainless Steel Rope Wire.
14. ASTM A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
15. ASTM A554: Standard Specication for Welded Stainless Steel Mechanical Tubing.
16. ASTM A563: Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
18. ASTM A666: Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
19. ASTM A741: Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail.
20. ASTM A780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
21. ASTM A786: Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
22. ASTM B26: Standard Specification for Aluminum-Allow Sand Castings.

23. ASTM B 209: Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
24. ASTM B 221: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
25. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
26. ASTM C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
27. ASTM D1187: Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
28. ASTM E488: Standard Test Methods for Strength of Anchors in Concrete Elements.
29. ASTM F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
30. ASTM F594: Standard Specification for Stainless Steel Nuts.
31. ASTM F1554: Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
32. ASTM F 1941: Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch, and Metric.

H. Federal Specifications:
1. Federal Specification RR-W-410: Wire Rope and Strand.

I. International Code Council Evaluation Service (ICC-ES):
1. ICC-ES AC58: Acceptance Criteria for Adhesive Anchors in Masonry Elements.
2. ICC-ES AC193: Acceptance Criteria for Mechanical Anchors in Concrete Elements.
3. ICC-ES AC308: Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

J. International Organization for Standardization (ISO):
1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).

K. Metal Framing Manufacturers Association (MFMA):
1. MFMA-4: Metal Framing Standards Publication.

L. Society for Protective Coatings (SSPC):
1. SSPC-Paint 20: Zinc-Rich Coating Inorganic and Organic.
2. SSPC-PA 1: Shop, Field, and Maintenance Painting of Steel.
3. SSPC-SP 3: Power Tool Cleaning.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide shop drawings for the following:

1. Steel framing and supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding Certificates.

B. Research Reports: For post-installed anchors.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, “Structural Welding Code - Steel.”
2. AWS D1.2, “Structural Welding Code – Aluminum.”
3. AWS D1.6, “Structural Welding Code - Stainless Steel.”

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Metal fabrications shall allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel:

1. Steel Plates, Shapes, and Bars: ASTM A36.

2. Steel Tubing: ASTM A500, cold-formed steel tubing.
3. Steel Pipe: ASTM A53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
4. Rolled-Steel Floor Plate: ASTM A786, rolled from plate complying with ASTM A36 or ASTM A283, Grade C or D.
5. Zinc-Coated Wire Rope: ASTM A741.
    a. Wire Rope Fittings: Hot-dipped galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
6. Recycled Content of Steel: As specified in "LEED v4 Requirements" Article.

C. Stainless-Steel:
1. Stainless-Steel Sheet, Strip, Plate: ASTM A240 or ASTM A666, Type 304.
2. Stainless-Steel Bars and Shapes: ASTM A276, Type 304.
3. Stainless-Steel Tubing: ASTM A554, Grade MT 304.
4. Stainless-Steel Pipe: ASTM A312, Grade TP 304.
5. Stainless-Steel Wire-Rope: Wire rope manufactured from stainless-steel wire complying with ASTM A492, Type 316.
    a. Wire-Rope Fittings: Stainless-steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

D. Aluminum:
1. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6, unless indicated otherwise.
2. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6, except as noted otherwise.
3. Aluminum Castings: ASTM B26, Alloy 443.0-F, except as noted otherwise.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum and stainless steel. Select fasteners for type, grade, and class required.

B. Steel Bolts, Threaded Rods, and Nuts: Regular hexagon-head bolts and threaded rods, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A489.
1. Closed eye with shoulder; lag screw, where indicated.

F. Machine Screws: ASME B18.6.3.

G. Lag Bolts: ASME B18.2.1.

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1.

J. Lock Washers: Helical, spring type, ASME B18.21.1.

K. Post-Installed Anchors: Fastener systems with working capacity calculated according to ICC-ES Acceptance Criteria indicated and ACI 318, greater than or equal to design load, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency, and according to evaluation report acceptable to authorities having jurisdiction, based on applicable substrate type.

1. At Concrete: One of the following:

a. Torque-Controlled Expansion Anchors: Working capacity calculated according to ICC-ES AC193.

i) Product: Subject to compliance with requirements, provide one of the following:

a) Hilti, Inc.; Kwik-Bolt TZ (KB-TZ), sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-1917.

b) Simpson Strong-Tie Company; Strong-Bolt 2, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3037.

c) Equal product in accordance with Division 1 requirements for product substitutions.

ii) Expansion Anchor Material: As indicated in referenced Product Report, and as follows:

a) Exterior: Stainless-steel, Alloy Group 1 (Type 304), ASTM F 593 and ASTM F594.

b) Interior: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn5, unless otherwise indicated.

b. Adhesive Anchors: Working capacity calculated according to ICC-ES AC308.

i) Product: Subject to compliance with requirements, provide one of the following:

a) Hilti, Inc.; HY 200, with HAS anchor rod, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3187.

b) Simpson Strong-Tie Company; ET-HP, with anchor rod sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3372.

c) Equal product in accordance with Division 1 requirements for product substitutions.

ii) Anchor Rod and Nut Material: As indicated in referenced Product Report, and as follows:

a) Exterior: Stainless-steel, Alloy Group 1 (Type 304), ASTM F593 and ASTM F594.

b) Interior: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn5, unless otherwise indicated.

2. At Masonry: Adhesive anchors. Working capacity calculated according to ICC-ES AC58.

a. Product: Subject to compliance with requirements, provide one of the following:

i) Hilti, Inc.; HY 70, with HAS anchor rod, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-2682.

ii) Simpson Strong-Tie Company; SET, with anchor rod sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-1772.

iii) Equal product in accordance with Division 1 requirements for product substitutions.

b. Anchor Rod and Nut Material: As indicated in referenced Product Report, and as follows:

i) Exterior: Stainless-steel, Alloy Group 1 (Type 304), ASTM F593 and ASTM F 594.

ii) Interior: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For stainless-steel fabrications, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Shop Primers: As specified in Section 09 91 00 “Painting.”

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Fabricate supports for operable partitions from continuous steel beams or channels of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize items occurring at exterior locations.

2.6 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts or post-installed anchors, and for grouting.

B. Galvanize plates after fabrication.

2.7 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete or masonry construction as needed to complete the Work. Provide each unit with integrally welded anchors for embedding in concrete or masonry as indicated on Drawings.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel anchors as indicated on Drawings for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.9 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL FINISHES

A. Finish steel and iron items as follows:

1. Hot-dip galvanize after fabrication, all items occurring at exterior locations.
    a. Steel pipe and tube downspouts to receive galvanized coating on both inner and outer surfaces.
2. Shop prime all items occurring at interior locations, except those items indicated to be galvanized or left unprimed.

B. Galvanizing: Hot-dip galvanize items as indicated.

1. Comply with applicable standard listed below:
    a. ASTM A123, for galvanizing steel products.

b. ASTM A153, for galvanizing steel and iron hardware.

2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

3. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

4. Rain downspouts fabricated from steel pipe or tube are to receive galvanized coating on both inner and outer surfaces.

5. If necessary, secure woven-wire fabric within frames after hot-dip galvanizing, in order to maintain flatness of fabric within frame.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Interiors (SSPC Zone 1A): SSPC-SP 3, “Power Tool Cleaning.”

D. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications of steel, except those with galvanized finishes and those to be embedded in concrete or masonry, or receive sprayed-on fireproofing, unless otherwise indicated. Comply with SSPC-PA 1, “Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel,” for shop painting.

1. Shop prime uncoated metal railings with primer specified in Section 09 91 00 “Painting.”

2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.11 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Stainless-Steel Tubing Finish:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.

D. Stainless-Steel Sheet and Plate Finish:

1. Directional Satin Finish: ASTM A480, No. 4.

E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.12 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish (Mill Finish): AA-M12.

C. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

G. Install manufactured items in accordance with written instructions of manufacturer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturer’s written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ***[overhead doors]*** securely to and rigidly brace from building structure.

C. Install steel columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in “Installing Bearing and Leveling Plates” Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting of Nongalvanized Steel and Iron Items: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

C. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

D. Check and adjust all operating hardware and moving parts for proper operation.

END OF SECTION 05 50 00

SECTION 06 41 00

ARCHITECTURAL WOOD CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Plastic-laminate-faced architectural cabinets.
   2. Plastic-laminate-faced countertops and splashes.
   3. Acrylic solid-surfacing material countertops and splashes
   4. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.

B. Related Sections include:
   1. Section 09 22 16 “Cold-Formed Non-Structural Metal Framing” for concealed metal backing in non-load-bearing metal stud-framed walls for anchoring cabinets.
   2. Division 22 Sections for plumbing fixtures installed in cabinets.

1.3 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI A208.1: Particleboard.
   2. ANSI A208.2: Medium Density Fiberboard (MDF) for Interior Applications.
   3. ANSI Z124.3: Plastic Lavatories.

B. American National Standards Institute (ANSI)/International Cast Polymer Association (ICPA):
   1. ANSI/ICPA SS-1: Performance Standard for Solid Surface Materials.

C. Architectural Woodwork Manufacturer’s Association of Canada/Woodwork Institute (AWMAC/WI):
   1. North American Architectural Woodwork Standards 3.1.

D. ASTM International:
   1. ASTM 36: Standard Specification for Carbon Structural Steel.
   2. ASTM C97: Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
   3. ASTM C170: Standard Test Method for Compressive Strength of Dimension Stone.
   4. ASTM C241: Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
   5. ASTM C482: Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement.

6. ASTM C484: Standard Test Method for Thermal Shock Resistance of Glazed Ceramic Tile.
7. ASTM C531: Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
8. ASTM C648: Standard Test Method for Breaking Strength of Ceramic Tile.
9. ASTM C650: Standard Test Method for Resistance of Ceramic Tile to Chemical Substances.
10.
11. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
12. ASTM C1028: Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dyanamometer Pull-Meter Method.
13. ASTM D523: Standard Test Method for Specular Gloss.
14. ASTM D570: Standard Test Method for Water Absorption of Plastics.
15. ASTM D635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
16. ASTM D638: Standard Test Methods for Tensile Properties of Plastics.
17. ASTM D695: Standard Test Method for Compressive Properties of Rigid Plastics.
18. ASTM D785: Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
19. ASTM D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
20. ASTM D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
21. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

E. Builders Hardware Manufacturers Association (BHMA):
1. BHMA A156.9: Cabinet Hardware.
2. BHMA A156.18: Materials and Finishes.

F. California Air Resources Board:
1. Airborne Toxic Control Measure to Reduce Formaldehyde Emissions From Composite Wood Products.
2. Suggested Control Measure for Architectural Coatings.

G. California Building Code (CBC) – California Code of Regulations, Title 24, Part 2.

H. California Code of Regulations – Title 17 - Public Health.

I. California Department of Public Health (CDPH):
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

J. Code of Federal Regulations (CFR):

1. 21 CFR, Chapter 1, Part 177, Section 177.2600: Substances for Use Only as Components of Articles Intended for Repeated Use.

K. European Standards (EN):
1. EN 15804: Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products.

L. Food and Drug Administration (FDA).

M. Forest Stewardship Council (FSC):
1. FSC STD-01-001: FSC Principles and Criteria for Forest Stewardship.
2. FSC STD-40-004: FSC Standard for Chain of Custody Certification.

N. Hardwood Plywood & Veneer Association (HPVA):
1. HPVA HP-1: Hardwood and Decorative Plywood.

O. Glass Association of North America (GANA):
1. Glazing Manual.

P. International Organization for Standardization (ISO):
1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).
2. ISO 14025: Environmental Labels and Declarations – Type III Environmental Declarations – Principals and Procedures.
3. ISO 14040: Environmental Management – Life Cycle Assessment – Principals and Framework.
4. ISO 14044: Environmental Management – Life Cycle Assessment – Requirements and Guidelines.
5. ISO 21930: Sustainability in Building Construction – Environmental Declaration of Building Products.

Q. International Solid Surface Fabricators Association (ISSFA):
1. ISSFA-2: Classification and Standards Publication of Solid Surfacing Material.

R. Laminating Materials Association (LMA):
1. LMA EDG-1: Voluntary Product Standard and Typical Physical Properties of Edgebanding Materials.

S. National Electrical Manufacturers Association (NEMA):
1. NEMA LD-3: High-Pressure Decorative Laminates.

T. South Coast Air Quality Management District (SCAQMD):
1. Rule 1113 – Architectural Coatings.
2. Rule 1168 – Adhesive and Sealant Applications.

U. UL Environment:
1. GREENGUARD Gold certification program.

V. Woodwork Institute (WI):

1. Certified Compliance Program.

1.4 DEFINITIONS

A. Composite Wood Product: Manufactured product using derivative wood materials such as strands, chips, particles, or fibers bonded together with a resin binder to form a rigid panel. Composite wood products include medium density fiberboard, particleboard, and hardboard.

B. DSA: Division of the State Architect.

C. Plastic-Laminate: High-pressure decorative laminate.

D. PVC: Polyvinyl chloride.

E. VOC: Volatile organic compound.

1.5 COORDINATION

A. Coordinate sizes and locations of concealed framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural wood cabinets can support loads imposed by installed and fully loaded cabinets.

B. Coordinate locations of utilities that will penetrate countertops or splashes.

C. Coordinate design and fabrication of cabinets to receive and support the following built-in items specified in other Sections. Verify dimensions and weights of all items and locations of all utility connection points and anchorages, and indicate on Shop Drawings.

1. Appliances specified in Section 11 31 00 “Residential Appliances”.

a. Verify dimensions and electrical/plumbing connections of built-in appliances to be provided by Owner.

1.6 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site to review pertinent issues related to architectural wood cabinets.

1.7 ACTION SUBMITTALS

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

1. Cabinet hardware and accessories.
2. High-pressure decorative laminate.
3. Low-pressure decorative laminate.
4. PVC edgebanding material.
5. Acrylic solid-surfacing material.
6. Adhesives for bonding plastic-laminates and wood veneers.
7. Finishing materials and processes.

B. Shop Drawings: Submit shop drawings in conformance with AWI/AWMAC/WI Architectural Woodwork Standards 3.1, Section 1, showing location of each item, dimensioned plans and elevations, large-scale construction details, attachment devices, and other components.

Shop drawings shall be reviewed by an independent WI Inspector (not the millwork contractor) and bear the WI Certified Compliance Program label, affixed to the first page of each set of the shop drawings.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking/backing and reinforcement specified in other Sections.
3. Show countertop materials, finishes, edge, backsplash, and endsplash profiles, methods of joining, and cutouts for plumbing fixtures and other items occurring in countertop or splash.
    a. Show locations and details of joints.
    b. Show directional pattern, if any.
    c. For acrylic solid-surfacing material, indicate seams.
        i) Indicate orientation of directional pattern of each sheet of material.
        ii) Indicate cross-sectional detail of each seam.
4. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, appliances, electrical switches and receptacles, and other items installed in architectural wood cabinets.

C. Samples for Verification:

1. High-pressure decorative laminate-clad panel products, 4 inches by 6 inches for each type, color, pattern, and surface finish, with corresponding PVC edgebanding applied to one edge.
2. Low-pressure decorative laminate-surfaced panel products, 4 inches by 6 inches for each type, color, pattern, and surface finish.
3. Acrylic solid-surfacing material, for each color, 6 inches by 6 inches.
    a. Indicate full range of color and pattern variation.
    b. For material with directional patterns, fabrication sample of each seam, edge, and corner condition, showing orientation of directional patterns of adjacent sheets of solid-surfacing material.
4. Cabinet hardware and accessories, one unit for each type and finish.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator. Demonstrate capabilities and experience.

1. Include list of completed projects with project names, addresses, and names of Owners and Architects.

1.9 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates, as specified in “Quality Assurance” Article.

B. Maintenance Data: For acrylic solid-surfacing countertops to include in maintenance manuals. Include manufacturer’s written cleaning instructions.

1.10 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

C. Quality Standard: Comply with the AWMAC/WI North American Architectural Woodwork Standards 3.1, for grades of architectural wood cabinets and countertops indicated for construction, finishes, installation, and other requirements.

1. WI Quality Marking: Mark each unit of the following types of architectural wood cabinets and countertops with WI Certified Compliance Label on an unexposed surface, indicating compliance with specified quality grade.
    a. Cabinets.
    b. Plastic-laminate countertops.
    c. Acrylic solid-surfacing countertops, splashes
2. WI Certificate of Compliance: Before delivery to the jobsite, obtain from WI, a Certified Compliance Certificate for materials and workmanship certifying that cabinet products fully meet requirements of the grades specified.
    a. Upon completion of installation, obtain from WI, a Certified Compliance Certificate, certifying that installation is in compliance with specified AWMAC/WI requirements.
3. The Contract Documents may contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.
4. If, for any reason, a reinspection is requested of Work required to be manufactured in accordance with the Architectural Woodwork Standards, and for which a fee is charged, said fee (if millwork is found to be non-conforming in any manner) shall be the responsibility of the Contractor and subsequently deducted from the contract price in form of a deductive change order.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and execution.

1. Build mockups of typical architectural wood base cabinet, countertop, and upper cabinet as shown on Drawings
2. Cabinet sample shall have removable countertop; one drawer; door with one adjustable shelf, toe space/base, complete with hardware as specified.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protect cabinets and countertops during transit, delivery, storage, and handling to prevent damage.

B. Do not deliver cabinets until painting and similar operations that could damage cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in “Field Conditions” Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.12 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work in space is complete and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

1. Comply with cabinet fabricator and Installer’s recommendations for optimum temperature and humidity conditions for cabinets during storage and installation. Maintain recommended conditions through remainder of construction period.

B. Field Measurements: Where cabinets and countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawing.

2. Verify dimensions of countertops by field measurements after base cabinets are installed, but before countertop fabrication is complete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Single-Source Manufacturing and Installation Responsibility: Engage a qualified woodworking firm to assume undivided responsibility for production of architectural wood cabinets specified in this Section, including fabrication, ***[and]*** installation***[, and finishing]***.

2.2 PERFORMANCE REQUIREMENTS

A. Design wall-hung and -anchored cabinets, storage shelving and connections with sufficient strength to resist stresses imposed by design loads as follows:

1. Vertical Design Loads: Per 2019 California Building Code, Table 1607A.1, Item 36, Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads.

2. Seismic Loads: Earthquake motions determined according to requirements of the California Building Code and Seismic Design Category specific to project.

3. Adjustable Shelf Loading: Provide ***[50]*** lbs/sq ft load bearing capacity, as per AWMAC/WI North American Architectural Woodwork Standards – 3.1, Section 10 (maximum deflection: L/144).

2.3 PLASTIC-LAMINATE-FACED CABINETS

A. Quality Standard: Comply with applicable requirements of AWMAC/WI North American Architectural Woodwork Standards 3.1, Section 10, “Casework.”

1. Grade: Premium.
    a. This grade requirement applies to cabinets in storage rooms and closets, janitor (custodian) rooms and closets, and utility rooms, and supersedes the exception for these locations as occurs in AWMAC/WI North American Architectural Woodwork Standards – 3.1, Section 10, Introductory Information – Advisories.
2. Where Contract Documents indicate requirements beyond those of specified quality standard, comply with those requirements in addition to the quality standard.

B. AWMAC/WI Construction Style: Frameless.

C. AWMAC/WI Cabinet/Door Interface Style: Flush Overlay.
1. At cabinet doors, exposed-knuckle hinges shall be let (notched) into door edge as required to maintain consistent gap width between adjacent cabinet door panels.

[or]

2. At cabinet doors, exposed-knuckle hinges shall not be let (notched) into door edge.

D. Door and Drawer Front Profile: Square edge.

E. Finish by Surface Category (as defined in AWMAC/WI standard):
1. Exposed Outer Surfaces: High-pressure decorative laminate, NEMA LD 3.
    a. Grades:
        i) Horizontal Surfaces: Grade HGS (0.048-inch nominal thickness)
        ii) Vertical Surfaces: Grade VGS (0.028-inch nominal thickness).
        iii) Postformed Surfaces: Grade HGP (0.042-inch nominal thickness).
    b. Pattern Direction: Vertical for drawer fronts, doors, and fixed panels.
2. Exposed Inner Surfaces (includes open shelving without doors, surfaces around and behind open shelving without doors, behind glass doors, backside of doors, edges of doors and drawers, and underside of exposed shelving): High-pressure decorative laminate, same material, pattern, color and thickness as exposed outer surfaces.
3. Semi-Exposed Surfaces: Low-pressure decorative laminate.
    a. Color: White.
4. Concealed Backs of Panels with Exposed or Semi-Exposed Surfaces: As required by referenced quality standard.

F. Edge Treatment:
1. Cabinet Doors and Drawers: PVC edgebanding, 3 mm thickness.
2. Exposed Edge of Shelving: PVC edgebanding, 1 mm thickness

G. Colors/Patterns:
1. High-Pressure Decorative Laminate As specified in Section 09 06 00 ”Colors and Finishes”.
2. Low-Pressure Decorative Laminate: White.
3. PVC Edgebanding:
    a. For bidding purposes, assume a separate edgebanding color for each separate color of plastic-laminate.

2.4 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Comply with applicable requirements of AWMAC/WI North American Architectural Woodwork Standards 3.1, Section 11, “Countertops.”
   1. Grade: Premium.
   2. Where Contract Documents indicate requirements beyond those of specified quality standard, comply with those requirements in addition to the quality standard.

B. High-Pressure Decorative Laminate Grade for Horizontal Surfaces: NEMA LD 3, Grade HGS (0.048-inch nominal thickness), except as follows:
   1. Vertical Surfaces: Grade VGS (0.028-inch nominal thickness).
   2. Post-Formed Surfaces: Grade HGP (0.042-inch nominal thickness).

C. Edge Treatment: Same as laminate cladding on horizontal surfaces

D. Core Material: Particleboard or medium density fiberboard.
   1. Core Thickness: 1-1/8 inch.
   2. At sink areas, core material to be moisture-resistant grade, dyed green per WI standards, with Type II water-resistant adhesive, per AWI/AWMAC/WI Architectural Woodwork Standards, Appendix, “Adhesives Guidelines.”

E. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL (0.020-inch nominal thickness), on underside of countertop substrate.

F. Where end of cabinet is exposed (e.g. does not abut a wall), round off front corner of countertop to 3/4 inch radius.

G. Colors/Patterns: As specified in Section 09 06 00 ”Colors and Finishes.”

2.5 ACRYLIC SOLID-SURFACING COUNTERTOPS

A. Quality Standard: Comply with applicable requirements of AWMAC/WI North American Architectural Woodwork Standards 3.1, Section 11, “Countertops.”
   1. Grade: Premium.
   2. Where Contract Documents indicate requirements beyond those of specified quality standard, comply with those requirements in addition to the quality standard.

B. Material: Acrylic solid-surfacing material.
   1. Provide sheets of acrylic solid-surfacing material from the same production run.

C. Acrylic Solid-Surfacing Material Thickness: 1/2 inch.

D. Fabricate tops in one piece, unless dimensions of counter exceed maximum available dimensions of acrylic solid-surfacing material, in which case, indicate proposed seam locations on Shop Drawings for Architect’s review. Comply with acrylic solid-surfacing material manufacturer’s written recommendations and requirements of referenced quality standard for adhesives, sealers, fabrication, and finishing.
   1. Fabricate tops with edges of dimensions and configurations indicated.
   2. Fabricate tops with shop-applied splashes, as indicated.
      a. Splash Height: ***[6]*** inches.

b. Splash Profile: Square top, unless indicated otherwise.

E. Drill holes in countertops for plumbing fittings and other penetrations in shop.

F. Where end of countertop terminates at a wall, provide end splash.

G. Where end of cabinet is exposed (e.g. does not abut a wall), round off front corner of countertop to 3/4 inch radius.

H. Colors/Patterns: As specified in Section 09 06 00 ”Colors and Finishes.”

2.6 CABINET AND COUNTERTOP MATERIALS

A. General: Provide materials that comply with requirements of the AWMAC/WI quality standard for each type of cabinet and quality grade specified, unless otherwise indicated. Modifications of AWMAC/WI standards contained herein, and on the Drawings, shall govern and take precedence over AWMAC/WI grade rules.

B. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content: 5 to 10 percent.

C. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural wood cabinet and quality grade specified unless otherwise indicated.

1. Medium Density Fiberboard: ANSI A208.2, Grade 130.
   a. Recycled Content:
      i) Preconsumer: 92 percent minimum.
2. Particleboard: ANSI A208.1, Grade M-2.
   a. Recycled Content:
      i) Preconsumer: 92 percent minimum.
   b.
3. Formaldehyde Emissions:
   a. Complies with requirements specified in “CALGreen Requirements” Article.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or, if not indicated, as required by AWMAC/WI quality grade.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminate by one of the following:
   a. Formica Corporation.
   b. Nevamar Company, LLC; Decorative Products Division.
   c. Panolam Industries International Incorporated; Pionite Decorative Surfaces.
   d. Wilsonart International; Division of Premark International, Inc.
2. Color(s): Refer to Section 09 06 00 “Colors and Finishes”

E. Low-Pressure Decorative Laminate: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

F. Edgebanding: PVC, of thickness indicated; complying with LMA EDG-1.

1. Manufacturer: Subject to compliance with requirements, provide edgebanding by the following:
   a. Doellken Woodtape.
2. Color(s): Refer to Section 09 06 "Colors and Finishes"

G. Acrylic Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1 and applicable requirements of AWMAC/WI North American Architectural Woodwork Standards 3.1, Section 11, "Countertops."

1. Products:: Subject to compliance with requirements, provide one of the following:
   a. E.I. du Pont de Nemours and Company; Corian. or Approved Equal
2. Type: Standard type.
3. Adhesive: Product recommended by acrylic-solid-surfacing manufacturer.
4. Color(s): Refer to Section 09 06 00 "Colors and Finishes".

2.7 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural wood cabinets, except for items which are specified in Section 08 71 00 "Door Hardware."

1. Hardware Finishes: Where BHMA finish designations are referenced, provide finish that complies with BHMA A156.18.
   a. Satin Stainless-Steel: BHMA 630.

B. Hinges: Frameless concealed type (European style); BHMA A156.9, 170 degrees of opening.

1. Product: Provide one of the following:
   a. Blum, Inc.; Compact.
   b. Grass America; Nexis.

C. Drawer Slides for Other Than File Drawers: BHMA A156.9, Grade 1; 150 lb per pair load rating; full-extension; steel ball bearings; progressive movement; rail mount/disconnect; finish: clear zinc.

1. Product: Accuride; #4032.

D. Drawer and Door Pulls: Back mounted, solid metal wire pull; 4 inches center-to center, 7/8-inch clearance, 5/16 inch in diameter; finish: BHMA 630 (satin stainless steel).

1. Mockett; DP105A/6 Square Drawer Pull – Stainless Steel

E. Door Catches: Magnetic catch, adjustable; self-aligning; pull strength, 5 lbs; finish: aluminum.

1. Door Catches: Ives; #325.

F. Elbow Catches: Designed for use on inactive leaf of pair of locking cabinet doors; finish: BHMA 626.

1. Product: Ives; #2.

G. Adjustable Shelf Supports: Steel with pins for 5 mm diameter drilled holes; provide top pin for shelves occurring 5 feet or higher above floor; finish: satin nickel plated.

1. Product:

a. Shelves less than 5 feet above floor: Hafele; #282-24-710.

b. Shelves 5 feet or higher above floor: Hafele; #282-24-720.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: As indicated on Drawings, or if not indicated, select material type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, floors, and elsewhere as required for corrosion-resistance. Provide metal expansion sleeves or expansion bolts for post-installed anchors.

C. Adhesives: Type recommended by adhesive manufacturers to suit products and substrate conditions indicated.

1. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

D. Joint Sealant: Silicone joint sealant; ASTM C920, Type S (single-component), Grade NS (nonsag), Class 12.5.

1. Color: ***[Translucent]***.

2. Where being installed in food-handling areas, FDA-approved for direct contact with food.

a. Comply with 21 CFR 177.2600.

3. Unless precluded by use in food-handling areas, provide mildew-resistant type, where occurs in areas subject to moisture.

4. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

E. Metal Fabrications: Steel plate, ASTM A36; thicknesses as indicated; ground all welds smooth; dimensions as indicated.

1. Anchorage Clips: Bent plate.

2.9 FABRICATION

A. Provide cabinets complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate cabinets to dimensions, profiles, and details indicated.

D. Complete fabrication, including assembly, ***[finishing,]*** and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings, to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of cutout openings in countertop subtops and plastic-laminate-faced countertops with a coat of varnish.

F. Acrylic Solid-Surfacing**.** Fabricate according to acrylic solid-surfacing material manufacturer's written instructions for fabrication, seaming, and finishing, and with requirements of referenced quality standard.

1. Cutouts and Holes:

a. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

b. Counter-Mounted Plumbing Fixtures and Appliances: Prepare countertops in shop for field cutting openings for counter-mounted fixtures and appliances.

c. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2. Directional Patterns: Fabricate and assemble sheets such that layout of seams, orientation of directional patterns of adjacent sheets, and cross-sectional detail of seams achieves an overall monolithic appearance to greatest extent possible, in accordance with manufacturer's written instructions.

2.10 SHOP FINISHING

A. General: Shop-finish transparent finished interior architectural cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of Work.

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of cabinets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installing architectural cabinets and countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

1. Examine substrates to receive acrylic solid-surfacing material countertops and conditions under which countertops will be installed, with Installer present, for

compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition cabinets and countertops to average prevailing humidity conditions in installation areas for not less than 72 hours.

3.3 INSTALLATION

A. Quality Standard: Install cabinets and countertops to comply with requirements of AWMAC/WI North American Architectural Woodwork Standards 3.1 and quality grade specified for each type of cabinet and countertop in Part 2 of this Section.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking/backing built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

1. DSA-Approved Anchorages: Install cabinets in accordance with details shown.

D. Install cabinets and countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

1. Scribe and cut cabinets and countertops to fit adjoining work, refinish cut surfaces and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches on center with No. 12 screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips, or No. 12 sheet metal screws through metal backing or metal framing behind wall finish.

E. Countertops and Splashes: Anchor securely to base cabinets or other supports as indicated.

1. Install countertops and splashes level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to tolerance of 1/8 inch in 96 inches.
2. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
3. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
4. Plastic-Laminate Countertops:
    a. Anchor plastic-laminate countertops by screwing through corner blocks of base cabinets or other supports into underside of countertop.

b. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

i) Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

5. Acrylic Solid-Surfacing Countertops:

a. Anchor acrylic solid-surfacing material countertops to base cabinets and subtops using adhesive recommended in writing by manufacturer.

b. Align adjacent acrylic solid-surfacing material countertops and form seams to comply with manufacturer's written instructions and referenced quality standard using adhesive in color to match countertop. Install metal splines in kerfs at joints, and fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

c. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned.

d. Secure backsplashes and endsplashes to walls and countertop with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

e. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

i) Seal edges in particleboard or medium-density fiberboard subtops by saturating with varnish.

6. Seal junctures of tops, splashes, and walls with silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

a. Where occurring in food preparation area, use sealant approved for use in such areas.

b. Where occurring in areas subject to moisture but not involving food preparation, use mildew-resistant sealant.

F. Touch up finishing work specified in this Section after installation of cabinets. Fill nail holes with matching filler where exposed.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets and countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets and countertops on exposed and semiexposed surfaces.

1. Touch up shop-applied finishes to restore damaged or soiled areas.

D. Protection: Provide kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches on center. Remove protection at Substantial Completion.

END OF SECTION 06 41 00

SECTION 07 54 19

POLYVINYL CHLORIDE (PVC) ROOFING

PART 1 - GENERAL CONDITIONS

1.01 DESCRIPTION

A. Scope
To install a complete Sarnafil G 410 adhered feltbacked PVC roofing system including membrane, flashings and other components.

B. Related Work
The work includes but is not limited to the installation of:
1. Removal of existing roofing, flashings and LWIC (where necessary)
2. Substrate preparation
3. LWIC (replacement as needed)
4. Separation layers (Roof Coverboard)
5. Roof membrane
6. Fasteners
7. Adhesive for flashings
8. Roof membrane flashings
9. Walkways
10. Metal Flashings
11. Sealants

C. Upon successful completion of work the following warranties may be obtained:
1. Sika Corporation Warranty or approved equal manufacturer's warranty
2. Roofing Applicator Warranty

1.02 QUALITY ASSURANCE

A. This roofing system shall be applied only by a roofing applicator authorized prior to bid by Sika Corporation (Sika Corporation "Applicator").

B. A Sika Corporation Technical Service Representative will review the installed roof system wherever a System Warranty has been requested.

C. All work pertaining to the installation of membrane, flashings, and accessories shall only be completed by Applicator authorized by Sika Corporation in those procedures.

D. Roofing membrane manufacturer must have a demonstrated performance history of producing PVC roof membranes no less, in duration of years, than the warranty duration specified.

E. Roofing membrane and membrane flashings to be manufactured by membrane supplier and not private labeled.

F. Manufacturer to have a minimum ten years of experience recycling their membranes at the end of their service life back into new membrane products. Provide a minimum of five reference projects completed with new membrane produced from recycled membrane.

G. Applicable code/insurance requirements shall be identified by the Owner or Owner's representative.

1.03 SUBMITTALS

A. At the time of bidding, the Applicator shall submit to the Owner (or Representative) the following:

1. Copies of Specification.
2. Samples of each primary components to be used in the roof system and the manufacturer's current product data sheet for each component.
3. Written approval by the insulation manufacturer (as applicable) for use of the product in the proposed system.
4. Sample copy of Sika Corporation's warranty.
5. Sample copy of Applicator's warranty.
6. Safety Data Sheets (SDS)

1.04 CODE REQUIREMENTS

The Applicator shall submit evidence that the proposed roof system meets the requirements of the local building code and has been tested and approved or listed by an approved, codified testing organization. These requirements are minimum standards and no roofing work shall commence without written documentation of the system's compliance.

A. ASTM International:

1. ASTM C 1177: Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
2. ASTM C 1278: Standard Specification for Fiber-Reinforced Gypsum Panel.
3. ASTM C 1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
4. ASTM C 1371: Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
5. ASTM C 1549: Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
6. ASTM D 1079: Standard Terminology Relating to Roofing and Waterproofing.
7. ASTM D 1970: Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
8. ASTM D 3746: Standard Test Method for Impact Resistance of Bituminous Roofing Systems.
9. ASTM D 4272: Standard Test Method for Total Energy Impact of Plastic Films by Dart Drop.
10. ASTM D 4434: Standard Specification for Poly(Vinyl Chloride) Sheet Roofing.
11. ASTM D 5036: Standard Practice for Application of Adhered Poly(Vinyl Chloride) Sheet Roofing.
12. ASTM E 108: Standard Test Methods for Fire Tests of Roof Coverings.
13. ASTM E 903: Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
14. ASTM E 1980: Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
15. ASTM F 2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using in situ Probes.
16. ASTM G 152: Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

17. ASTM G 154: Standard Practice for Operating Flurorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.
18. ASTM G 155: Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials.

B. California Air Resources Board:
1. Suggested Control Measure for Architectural Coatings.

C. California Building Code (CBC) – California Code of Regulations, Title 24, Part 2.

D. California Energy Code – California Code of Regulations, Title 24, Part 6.

E. California Green Building Standards Code (CALGreen) – California Code of Regulations, Title 24, Part 11.

F. Code of Federal Regulations (CFR):
1. 40 CFR, Part 59, Subpart D (EPA Method 24): National Volatile Organic Compound Emission Standards.

G. Cool Roof Rating Council (CRRC):
1. CRRC-1: Product Rating Program.

H. Factory Mutual Global (FMG):
1. FM Approvals 4470: Approval Standard for Class 1 Roof Covers.

I. International Code Council (ICC):
1. ICC-ES: ICC Evaluation Service.

J. International Organization for Standardization (ISO):
1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).

K. National Roofing Contractors Association (NRCA):
1. The NRCA Roofing and Waterproofing Manual.
2. Quality Control Guidelines for the Application of Thermoset Single-Ply Roof Membranes

L. South Coast Air Quality Management District (SCAQMD):
1. Rule 1168 – Adhesive and Sealant Applications.

M. Underwriters Laboratories (UL):
1. UL 790: Standard Test Methods for Fire Tests of Roof Coverings.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All products delivered to the job site shall be in the original unopened containers or wrappings bearing all seals and approvals.

B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

C. Membrane rolls shall be stored lying down on pallets and fully protected from the weather with clean tarpaulins. Unvented tarpaulins are not accepted due to the potential accumulation of moisture beneath the tarpaulin which may affect the membrane weldability.

D. As a general rule all adhesives shall be stored at temperatures between 40°F (4°C) and 80°F (27°C). Read product data sheets and instructions contained on adhesive canisters for specific storage instructions.

E. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined on containers and read product Safety Data Sheets (SDS).

F. Any materials which the Owner's representative or Sika Corporation determine to be damaged are to be removed from the job site and replaced at no cost to the Owner.

G. Safety Data Sheets (SDS) shall be available at the job site at all times.

1.06 JOB CONDITIONS

A. Only as much of the new roofing as can be made weathertight each day, including all flashing and detail work, shall be installed. All seams shall be heat welded before leaving the job site that day.

B. Temporary overnight tie-ins shall be installed at the end of each day's work and shall be completely removed (including any contaminated materials) before proceeding with the next day's work.

C. The Applicator is cautioned that certain Sarnafil membranes are incompatible with asphalt, coal tar, heavy oils, roofing cements, creosote and some preservative materials. Such materials shall not remain in contact with these Sarnafil membranes.

D. The Applicator shall follow all safety regulations as required by OSHA and any other applicable authority having jurisdiction. Roof and walkways may be slippery when icy, snow covered, or wet. Working on surfaces under these conditions is hazardous. Appropriate safety measures must be implemented prior to working on such surfaces. Always follow OSHA and other relevant fall protection standards when working on roofs.

E. Where applicable, the Applicator shall arrange for pullout tests in accordance with the latest versions of the SPRI/ANSI Standard Field Test Procedures FX-1 and IA-1 for fasteners and adhesives, respectively, to verify condition of the deck/substrate and to confirm expected pullout values.

F. The Sarnafil membrane shall not be installed under the following conditions without consulting Sika Corporation's Technical Dept. for precautionary steps:

1. The roof assembly permits interior air to pressurize the membrane underside.
2. Any exterior wall has 10% or more of the surface area comprised of opening doors or windows.
3. The wall/deck intersection permits air entry into the wall flashing area.

G. Special consideration should be given to construction related moisture. Sika Corporation is not responsible for damage when exposed to construction related moisture.

1.07 BIDDING REQUIREMENTS

A. Pre-Bid Meeting:

A pre-bid meeting shall be held with the Owner's Representative and involved trades to discuss all aspects of the project. The Applicator's field representative or roofing foreman for the work shall be in attendance.

B. Site Visit:

Bidders shall visit the site and carefully examine the areas in question as to conditions that may affect proper execution of the work. All dimensions and quantities shall be determined or verified by the Applicator. No claims for extra costs will be allowed because of lack of full knowledge of the existing conditions unless agreed to in advance with the Owner or Owner's Representative.

1.08 WARRANTIES

A. Sika Corporation Warranty

Upon successful completion of the work to Sika Corporation's satisfaction and receipt of final payment, the Sika Corporation Warranty shall be issued.

1. System Warranty

B. Contractor Warranty

1.09 WARRANTY DURATIONS

A. Sika Corporation’s warranty shall be in effect for a 20 year duration.
B. Contractor warranty shall be in effect for a 5 year duration.

PART 2 - PRODUCTS

2.02 GENERAL

A. Components of the roof system shall be products of Sika Corporation as indicated on the Detail Drawings and specified in the Contract Documents.

B. Components that are other than those supplied or manufactured by Sika Corporation may be submitted for review and acceptance by Sika Corporation. Sika Corporation’s acceptance of any other product is only for a determination of compatibility with Sika Corporation products and not for inclusion in the Sika Corporation warranty. The specifications, installation instructions, limitations, and restrictions of the respective manufacturers must be reviewed by the Owner’s Representative for acceptability for the intended use with Sika Corporation products.

C. Consult respective product data sheets and selection guides for additional information.

2.03 MEMBRANE

A. Membrane shall conform to:
1. ASTM D-4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II.
2. NSF/ANSI Standard 347, “Sustainability Assessment for Single Ply Roofing Membranes”. Certification Level: Platinum.
3. The manufacture to guarantee that the membrane thickness meets or exceeds the specified thickness when tested according to ASTM D-751.

B. Sarnafil PVC thermoplastic membrane

1. Type of Membrane
   a) Sarnafil G 410 Feltback

2. Membrane Thickness
   a) 72 mil (1.8 mm)

C. Color of Membrane

1. Sarnafil G 410 Feltback Membrane
   a) EnergySmart White

D. Typical Physical Properties

1. Refer to individual Sarnafil G 410 Product Data Sheets for physical property values.

2.04 INSULATIONS / ROOF BOARDS

A. Insulation

1. Sarnatherm (Filler)
   Rigid polyisocyanurate insulation board with glass fiber reinforced felt facers, meeting ASTM C-1289 Type II, Class 1, Grade 2 (20 psi).

B. Roof Boards

1. DensDeck® Prime Roof Board
   Gypsum roof board with a primed fiberglass mat facer on one side, meeting ASTM C-1177.
   a) Thickness ½”

2.05 ATTACHMENT COMPONENTS

A. Membrane Adhesive

1. Sarnacol 2121 Adhesive
   Water-based, VOC compliant*, adhesive used to attach membrane.

B. Insulation / Roof Board Adhesive

1. Sarnacol 2163
   Two-component foamable polyurethane board adhesive applied in ribbons or full applications. No temperature restrictions.

C. Insulation / Roof Board Mechanical Attachment

1. Sarnaplate
   26 gauge, 3” (76 mm) square or round steel plate with a Galvalume coating, used with #12, #14, and #15 Sarnafasteners to attach Sarnatherm insulation, Sarnatherm roof boards, gypsum roof boards, or other Sika approved boards to the roof deck.

2. Sarnaplate Low Profile

22 gauge, 2-3/4” (70 mm) square steel plate with a Galvalume coating, used with #12, #14, and #15 Sarnafasteners to attach Sarnatherm insulation, Sarnatherm roof boards, gypsum roof boards, or other Sika approved boards to the roof deck.

3. Sarnafastener #12
   #12 corrosion-resistant fastener used with Sarnaplates to attach Sarnatherm insulation, Sarnatherm roof boards, gypsum roof boards, or other Sika approved boards to the roof deck.

4. Sarnafastener #14
   #14 corrosion-resistant fastener used with Sarnaplates to attach Sarnatherm insulation, Sarnatherm roof boards, gypsum roof boards, or other Sika approved boards to the roof deck.

5. Fastener CD-10
   Nail-in, corrosion-resistant fastener used with Sarnaplates to attach Sarnatherm insulation, Sarnatherm roof boards, gypsum roof boards, or other Sika approved boards to structural concrete.

2.06 FLASHING MATERIALS

A. Wall / Curb Flashing

1. Sarnafil G 410 Membrane
2. Sarnafil G 459 Flashing Membrane
   For use over residual asphalt or other contaminated surfaces.
3. Sarnaclad – PVC coated sheet metal flashing

B. Perimeter Edge Flashing

1. Sarnaclad
   24 gauge, G90 galvanized steel with PVC-coating on one side for heat-weldability.

C. Miscellaneous Flashing

1. Sarnacircles
   Round circle patch.

2. Sarnacorners - Inside
   Injection molded inside corner.

3. Sarnacorners - Outside
   Injection molded outside corner.

4. Sarnastack Universal
   Injection molded stack/pipe boot to flash pipes, vent stacks and cylindrical penetrations.

5. Sarnastack Split A, B, C

Prefabricated stack/pipe boot open along one side to flash pipes, vent stacks and cylindrical penetrations when access is obstructed.

6. Open Post Flashing
   Prefabricated pipe boot open along one side to flash rooftop conduits, pipes, and cylindrical penetrations when access is obstructed.

7. Sarnareglet
   Extruded aluminum flashing termination reglet used at walls and large curbs for exposed applications. Use prefabricated Sarnareglet mitered inside and outside corners where walls intersect.

8. Liquid Flashing Primer
   Two-component polymethyl methacrylate-based (PMMA) primer used to promote the adhesion of Liquid Flashing SW and Liquid Flashing WW over wood and concrete surfaces.

9. Liquid Flashing Fleece
   Non-woven, needle-punched polyester fleece used as the reinforcement for Sika's liquid flashing details.

10. Liquid Flashing Catalyst
    Reactive agent based on dibenzoyl peroxide to induce curing of Sika's Liquid Flashing SW, Liquid Flashing WW, and Liquid Flashing Primer when mixed.

11. Liquid Flashing SW (summer-grade white)
    Two-component polymethyl methacrylate-based (PMMA). The ambient temperature at application must be between 59°F (15°C) and 104°F (40°C). The surface temperature at application must be between 59°F (15°C) and 122°F (50°C).

12. Liquid Flashing WW (winter-grade white)
    Two-component polymethyl methacrylate-based (PMMA). The ambient and surface temperatures at application must be between 23°F (-5°C) and 68°F (20°C).

2.07 WALKWAY PROTECTION

A. Sarnatred-V
Polyester reinforced, 96 mil (2.4 mm) thick, weldable membrane with surface embossment similar to a chevron pattern. Used as a protection layer from rooftop traffic.

2.08 MISCELLANEOUS ACCESSORIES

A. Aluminum Tape
2" (51 mm) wide pressure-sensitive aluminum tape used as a separation layer between small areas of asphalt contamination and the membrane and as a bond-breaker under the coverstrip at Sarnaclad joints.

B. Multi-Purpose Tape ST
Tape used to seal membrane at penetrations and securements, metals, or Vapor Retarder PE 10.

C. Perimeter Warning Membrane
4" (10.2 cm) wide yellow Sarnafil G 410 Membrane used in required areas.

D. Seam Cleaner

Used to clean adhesive out of seams. It is not to be used as a general membrane cleaner. It is also used to clean metal and reactivate existing Liquid Flashing prior to the application of new Liquid Flashing.

E. Sarnadisc

20 gauge, 2” (51 mm) round steel disc with Galvalume coating, used with #14 or #15 XP Sarnafasteners or Fastener CD-10 to attach the Sarnafil roof membrane to the roof deck at the base of walls, curbs, and other roof penetrations.

F. Sarnastop

1” wide extruded aluminum, low profile bar used with certain Sarnafasteners to secure membrane to the roof deck or to walls/curbs at terminations, penetrations and at angle changes of the substrate.

2.09 SEALANTS AND PITCH POCKET FILLERS

A. Sikaflex-1a

Moisture-cured, one-component polyurethane-based, non-sag elastomeric sealant used in wall, curb and drain terminations. It is also used as a sealant at pipe penetrations and under certain metal flashings. Sikaflex-1a can be used as a pourable sealer pocket filler.

B. Sarnafiller

Two-component urethane adhesive for pitch pocket toppings.

2.10 MISCELLANEOUS FASTENERS AND ANCHORS

All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel. Mixed metal type components shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins.

2.11 RELATED MATERIALS

A. Wood Nailer

Code compliant wood nailers shall be installed at the perimeter of the entire roof and around such other roof projections and penetrations as specified on Project Drawings. Thickness of nailers must match the height of the insulation and roof board to achieve a smooth transition.

B. Plywood

When bonding directly to plywood, a minimum 1/2” (13 mm) CDX (C side out), smooth-surfaced exterior grade plywood with exterior grade glue shall be used. Rough-surfaced plywood or high fastener heads will require the use of Sarnafelt behind the flashing membrane. Plywood shall have a maximum moisture content of 19% by weight on a dry weight basis.

PART 3 - EXECUTION

3.02 PRE-CONSTRUCTION CONFERENCE

The Applicator, Owner's Representative/Designer and Manufacturer(s) shall attend a pre-construction conference.

3.03 SUBSTRATE CONDITION

A. Applicator shall be responsible for acceptance or provision of proper substrate to receive new roofing materials.

B. Applicator shall verify that the work done under related sections meets the following conditions:
1. Roof drains and scuppers have been reconditioned or replaced (as applicable) and installed properly.
2. Roof curbs, nailers, equipment supports, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.

C. The substrate shall be clean, smooth, dry, free of water, ice and snow and free of flaws, sharp edges, loose and foreign material, oil, grease and other contaminants. Roofing shall not start until all defects have been corrected.

3.04 SUBSTRATE PREPARATION

The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. The Owner's Representative shall ensure that the roof deck is secured to the structural framing according to local building code or insurance requirements and in such a manner as to resist all anticipated loads in that location.

A. Reroofing with Removal of Existing Roofing System

All existing roofing, base flashing, deteriorated wood blocking or deteriorated metal flashings shall be removed. Remove only that amount of roofing and flashing which can be made weathertight with new materials during a one-day period or before the onset of inclement weather.

1. Steel Deck
   All rusted or deteriorated decking shall be brought to the attention of the Owner's Representative to determine method of treatment or replacement. Surface-only rusted metal shall be sanded and treated with rust-inhibiting paint. Sections that have rusted deeper than the surface or are not structurally sound shall be removed and replaced. Deck type shall match existing and the attachment shall conform to local code requirements.

2. Poured Lightweight (Cellular or Insulating) Concrete Substrate
   Sharp ridges or other projections above the surface shall be removed before roofing. Fastening for recover board shall be into structural deck below insulating fill (see steel/concrete deck requirements).

3.05 INSULATION / ROOF BOARD INSTALLATION

General Criteria:
1. Boards shall be installed according to local building code, insurance requirements, and manufacturer's instructions.
2. Boards shall be neatly cut to fit around penetrations and projections.
3. Install tapered insulation in accordance with insulation manufacturer's shop drawings.
4. Do not install more board than can be covered with membrane by the end of the day or the onset of inclement weather.

5. When two or more layers of insulation and/or roof boards are used, stagger joints at least 12” (30.5 cm) in both directions between layers.
6. Refer to individual Product Data Sheets (PDS) and *Insulation or Roof Board Installation* section of Sika Sarnafil Roofing Applicator Handbook for detailed installation instructions.

A. Mechanical Attachment

Boards shall be mechanically fastened to the deck with approved fasteners and plates according to the wind uplift rating requirements and associated fastening patterns.

B. Attachment with Board Adhesives

Boards shall be adhered to the deck with approved adhesives according to the wind uplift rating requirements and associated ribbon spacing patterns. The maximum board size with board adhesives is 4 ft x 4 ft (1.2 m x 1.2 m) for insulation boards and 4 ft x 8 ft (1.2 m x 2.4 m) for roof boards.

C. Lightweight Insulating Concrete

Install in accordance with selected manufacturer’s guidelines.

3.06 SARNAFIL G 410 MEMBRANE INSTALLATION

The surface of the insulation, roof board, or substrate shall be inspected prior to installation of the Sarnafil roof membrane. The substrate shall be clean, dry, and free from debris and smooth with no surface roughness or contamination. Broken, delaminated, wet or damaged boards shall be removed and replaced. Tack welding of Sarnafil G 410 membrane field sheets for purposes of temporary restraint during installation is not permitted and may result in voiding of Sika Corporation warranty.

A. Sarnacol 2121 Adhesive:

1. Apply adhesive direct to substrate, rate may vary depending on porosity of substrate. Do not allow adhesive to skin-over or surface-dry prior to installation of Sarnafil membrane.

2. Refer to Sarnacol 2121 Product Data Sheet and *Adhered Systems: Water Based Adhesive Installation* section of Sika Sarnafil Roofing Applicator’s Handbook for detailed installation instructions.

3.07 HOT-AIR WELDING OF MEMBRANE OVERLAPS

A. All membrane overlaps shall be hot-air welded. The membrane shall be clean and dry prior to hot-air welding.

B. Field membrane overlaps for automatic machine-welding shall be 3” (76 mm) in width. A minimum of 4” (10.2 cm) wide overlap is required when hand-welding details.

C. 1” (25 mm) wide cross-section samples of welded seams shall be taken at least two times a day, once in the morning and once in the afternoon.

D. Refer to *Welding* section of Sika Sarnafil Roofing Applicator Handbook for detailed installation instructions.

3.08 MEMBRANE FLASHING INSTALLATION

All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Owner's Representative and Sika Corporation. Approval shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing, the affected area shall be removed and replaced at the Applicator's expense. Flashing shall be adhered to compatible, dry, and smooth surfaces free of dirt, dust, and debris. Use caution to ensure adhesive fumes are not drawn into the building.

A. All flashings should extend a minimum of 8” (20.3 cm) above finished roofing level. Submit requests for exceptions in writing to the Owner's Representative and Sika Corporation Technical Department for signed approval.

B. No bitumen shall be in contact with any Sarnafil membranes except Sarnafil G 459.

C. All flashing membranes shall be mechanically fastened along the counter-flashed top edge with Sarnastop or approved Sarnadisc at 6 - 12” (15.2 – 30.5 cm) on center.

D. Sarnafil flashings shall be terminated according to Sika Corporation recommended details.

E. All adhered flashings that exceed 45” (1.14 m) in height shall receive additional securement, unless applying Sarnafil G 410 SA membrane to plywood, DensDeck Prime, glass-faced polyisocyanurate, or smooth poured concrete with a concrete surface profile range of CSP 2 to CSP 5 according to ICRI Technical Guideline No. 310.2R-2013.

F. Refer to *Typical Flashing Procedures* section of Sika Sarnafil Roofing Applicator Handbook for detailed installation instructions.

3.09 LIQUID FLASHING INSTALLATION

A. Application Guidelines

Liquid Flashing has a strong odor. Precautions should be taken to prevent odors and/or vapors from entering the building/structure, including but not limited to turning off and sealing air intake vents and other means of ingress for odors and/or vapors into the building/structure during product application and cure. Refer to individual Product Data Sheets (PDS) and *Liquid Flashing Procedures* section of Sika Sarnafil Roofing Applicator Handbook for detailed installation instructions.

B. Installation Notes

1. Prepare the surface to be flashed by cleaning the area to like-new condition.
2. Pre-cut vertical and horizontal liquid flashing fleece to fit around the penetration with 2” (51 mm) overlaps.
3. Thoroughly mix the Liquid Flashing and the Liquid Flashing Catalyst with a slow speed mixer.
4. Apply the catalyzed liquid flashing with a 55 mil base layer. Place the pre-cut fleece into the wet Liquid Flashing making sure to saturate the fleece. Apply a 25 mil finishing layer over the fleece.

C. Inspection and Quality Control

Refer to Sika Sarnafil Technical Bulletin 19-02 for detailed inspection procedures.

3.10 SARNACLAD METAL BASE FLASHINGS / EDGE METAL INSTALLATION

A. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Owner's

Representative and Sika Corporation. Approval shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing due to incomplete flashings, the affected area shall be removed and replaced at the Applicator's expense.

B. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:
   1. ANSI SPRI ES-1 (latest issue).
   2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - latest issue.

C. Pre-formed metal flashing shall be installed according to metal manufacturer’s guidelines.

D. Metal, other than that provided by Sika Corporation, is not covered under the Sika Corporation warranty.

E. Sarnaclad and other metal flashings shall be formed and installed per the Detail Drawings. Refer to individual Product Data Sheets (PDS) and *Metal Flashings* section of Sika Sarnafil Roofing Applicator Handbook for detailed installation instructions.

3.11 WALKWAY INSTALLATION

A. Sarnatred-V

Probe all existing deck membrane seams which are to be covered by Sarnatred-V. Install walkway in straight lines by either adhering and welding or just welding to the field membrane.

B. Refer to individual Product Data Sheets (PDS) and *Walkway Installation* section of Sika Sarnafil Roofing Applicator Handbook for detailed installation instructions.

3.12 PERIMETER WARNING INSTALLATION

Application areas must be cleaned to a like-new condition. For detailed installation instructions, refer to individual Product Data Sheets (PDS).

C. Membrane: Perimeter Warning Membrane is hot-air welded to the top of PVC roofing membrane in the areas required.

3.13 TEMPORARY CUT-OFF

A. All flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses. All temporary cut-offs shall be constructed to provide a watertight seal. The new membrane shall be carried into the temporary cut-off. Temporary cut-off shall be sealed to the deck or substrate so that water will not be allowed to travel under the new or existing roofing. When work resumes, the contaminated membrane shall be cut out.

B. If inclement weather occurs while a temporary cut-off is in place, the Applicator shall provide the labor necessary to monitor the situation to maintain a watertight condition.

C. If any water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Applicator's expense.

D. Refer to *Overnight Tie-In* section of Sika Sarnafil Roofing Applicator Handbook for detailed instructions.

3.14 COMPLETION

A. Prior to demobilization from the site, the work shall be reviewed by the Owner's Representative and the Applicator. All defects noted and non-compliances with the Specifications or the recommendations of Sika Corporation shall be itemized in a punch list. These items must be corrected immediately by the Applicator to the satisfaction of the Owner's Representative and Sika Corporation prior to demobilization.

B. All Warranties referenced in this Specification shall have been submitted and have been accepted by the owner or owner’s representative at time of contract award.

END OF SECTION

SECTION 08 11 13

HOLLOW-METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Hollow-metal steel doors.
   2. Hollow-metal steel frames for doors and glazed openings.

B. Related Sections include:
   1. Section 07 92 00 “Joint Sealants” for sealant joints between perimeter of hollow-metal frames and adjacent construction.
   2. Section 08 71 00 “Door Hardware” for finish hardware installed on hollow-metal doors and frames.
   3. Section 08 81 00 “Glass Glazing” for glass installed in hollow-metal frames and doors.
   4. Section 08 88 13 ”Fire-Rated Glazing” for fire-rated glass installed in fire-rated hollow-metal doors and frames.
   5. Section 09 91 00 “Painting” for field painting of hollow-metal doors and frames.

1.3 REFERENCES

A. ASTM International:
   1. ASTM A 153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   2. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   3. ASTM A 780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   4. ASTM A 879: Standard Specification for Steel Sheet, Zinc-Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
   5. ASTM A 1008: 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.
   6. ASTM A 1011: 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.
   7. ASTM C 665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

8. ASTM E 136: Standard Test Method for Behavior of Materials in Vertical Tube Furnace at 750°C.

B. Builder's Hardware Manufacturers Association (BHMA):
   1. ANSI/BHMA A156.115: Standard for Hardware Preparation in Steel Doors and Steel Frames.

C. European Standards (EN):
   1. EN 15804: Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products.

D. International Organization for Standardization (ISO):
   1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).
   2. ISO 14025: Environmental Labels and Declarations – Type III Environmental Declarations – Principals and Procedures.
   3. ISO 14040: Environmental Management – Life Cycle Assessment – Principals and Framework.
   4. ISO 14044: Environmental Management – Life Cycle Assessment – Requirements and Guidelines.
   5. ISO 21930: Sustainability in Building Construction – Environmental Declaration of Building Products.

E. National Association of Architectural Metal Manufacturers/Hollow Metal Manufacturers Association (NAAMM/HMMA):
   1. NAAMM-HMMA 803: Steel Tables.

F. National Fire Protection Association (NFPA):
   1. NFPA 80: Standard for Fire Doors and Other Opening Protectives.
   2. NFPA 105: Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.
   3. NFPA 252: Standard Methods for Fire Tests of Door Assemblies.
   4. NFPA 257: Standard on Fire Test for Window and Glass Block Assemblies.

G. Society for Protective Coatings (SSPC):
   1. SSPC-Paint 20: Zinc-Rich Coating, Type I – Inorganic and Type II – Organic.
   2. SSPC-SP1 Solvent Cleaning.
   3. SSPC-SP 3: Power Tool Cleaning.
   4. SSPC-SP 6/NACE No. 3: Commercial Blast Cleaning.

H. Steel Door Institute (SDI):
   1. ANSI/SDI A250.4: Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, and Frame Anchors.
   2. ANSI/SDI A250.6: Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

3. ANSI/SDI A250.8 (Formerly SDI-100): Recommended Specifications for Standard Steel Doors and Frames.
4. ANSI/SDI A250.10: Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11: Recommended Erection Instructions for Steel Frames.
6. SDI 111-C: Recommended Louver Details for Standard Steel Doors.

I. Underwriters Laboratory (UL):
1. UL 9: Fire Tests of Window Assemblies.
2. UL 10C: Positive Pressure Fire Tests of Door Assemblies.
3. UL 1784: Air Leakage Tests of Door Assemblies.

1.4 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.5 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware.

1.6 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site to review pertinent issues related to hollow-metal doors and frames.

1.7 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, fire-resistance and temperature-rise ratings, and finishes for each type of hollow-metal door and frame specified.

B. Shop Drawings: Include the following:
1. Elevation of each door type.
2. Details of doors, including vertical- and horizontal-edge details, and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

9. Existing Conditions: Where new doors are indicated to be installed in existing frames, or existing door is indicated to be removed and reinstalled, field verify all existing conditions and dimensions. Notify Architect of any conditions that would prevent installation of scheduled door and hardware as required for proper operation and normal maintenance.
    a. Indicate date of project site visit on submittal. Submittals prepared without project site visit for field verification will be returned as non-compliant.

C. Samples for Verification:
1. Fabrication: Prepare Samples approximately 12 inches by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
    a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.8 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking, except place on higher blocking when needed to protect hollow-metal work from moisture or other harmful conditions. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.10 FIELD CONDITIONS

A. Existing Openings: Where new hollow-metal doors and hardware are scheduled for installation in existing frames or where modifications to existing doors and frames is required, field verify existing conditions and coordinate installation of door and hardware to suit opening conditions and to provide for proper operation and maintenance. Refer to Shop Drawing requirements in “Action Submittals” Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain hollow-metal doors and frames through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings ***[and temperature-rise limits]*** indicated.

1. Test Pressure: Test at positive pressure according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.
3. Temperature-Rise Rating: At interior exit stairways, interior exit ramps, and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
4. Smoke- and Draft-Control Assemblies: Provide assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

2.3 HOLLOW-METAL DOORS AND FRAMES, GENERAL

A. Hollow-Metal Doors and Frames: Complying with SDI A250.8 as indicated.

1. Manufacturers: Subject to compliance with requirements, provide hollow-metal doors and frames by one of the following:
   a. Ceco Door Products; an ASSA ABLOY Group company.
   b. Curries Company; an ASSA ABLOY Group company.
   c. Door Components, Inc.
   d. Steelcraft; an Allegion brand.
   e. Stiles Custom Metal, Inc.
   f. Manufacturer of equal products in accordance with Division 1 requirements for product substitutions.

B. Environmental Product Declaration: Provide hollow-metal doors and frames from manufacturer with valid Environmental Product Declaration, complying with requirements in “LEED v4 Requirements” Article.

2.4 HOLLOW-METAL DOORS

A. Construct hollow-metal doors to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances and clearances, and as specified.

B. Hollow-Metal Doors: Complying with SDI A250.8, Level 3 (Extra-Heavy-Duty).

1. Physical Performance: Level A according to SDI A250.4.
2. Type: Flush.
3. Thickness: 1-3/4 inches.
4. Faces: 0.053-inch thick (16 gage) metallic-coated steel sheet with minimum A40 (ZF120) coating.
5. Edge Construction: Model 2, Seamless.
    a. Top Edge Closure: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    b. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets.
    c. Provide beveled strikeside jamb edge per referenced standards.
6. Core: Manufacturer's standard kraft-paper honeycomb, except as follows:
    a. At fire-protection-rated doors, provide core as required to meet fire-protection and temperature-rise ratings indicated.
7. Moldings for Glazed Lites in Doors: Minimum 0.032-inch thick (20 gage), fabricated from same material as door face sheet in which they are installed.
8. Concealed Reinforcing: Fabricated reinforcement plates from metallic-coated steel sheet, in thickness and dimensions as required for proper reinforcing and support for hinges, locks, flush bolts, closers, holders, and other hardware items
9. Finish: Factory-primed.

2.5 HOLLOW-METAL FRAMES

A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances and clearances, and as specified.

B. Interior Hollow-Metal Frames: Complying with SDI 250.8, Level 3 (Extra-Heavy-Duty), except as noted otherwise below.

1. Frame Material: 0.053-inch thick (16 gage) uncoated steel sheet.
2. Construction: Full-profile welded.
3. Finish: Factory-primed.
4. Concealed Stiffeners and Reinforcing: Fabricated reinforcement plates from uncoated steel sheet, in thickness and dimensions as required for proper reinforcing and support for hinges, locks, flush bolts, closers, holders, and other hardware items.
5. Loose Stops for Glazed Lites in Frames: Fabricated from uncoated steel sheet, minimum 0.032 inch thick (20 gage). Prepared for countersink style screws. Finish to match frame.
6. Anchors: Formed from same material as frames except as noted otherwise below:

a. Jamb Anchors: Provide minimum size, type, and quantity required by applicable door and frame standard, and suitable for performance level indicated.

i) Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, metallic-coated steel sheet not less than 0.042-inch thick (18 gage), with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or metallic-coated wire anchors not less than 0.177-inch thick.

ii) Stud-Wall Type: Designed to engage studs, welded to back of frames; not less than 0.042-inch thick (18 gage).

iii) Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

b. Floor Anchors: Formed from same material as frame, minimum thickness of 0.042-inch (18 gage), and as follows:

i) Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

ii) Separate Topping Concrete Slabs or Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of topping slab or underlayment.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879, Commercial Steel, (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips of other accessory devices for attaching hollow-metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements of Section 08 81 00 “Glass Glazing.”

2.7 FABRICATION

A. Fabricate hollow-metal doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Fire Door Cores: As required to provide fire-protection ***[and temperature-rise]*** ratings indicated.
2. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
3. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
4. Glazed Lites: Factory cut openings in doors.
5. Astragals: If required to comply with published listing of qualified testing agency for fire-performance rating, provide overlapping astragal on one leaf of pairs of doors per NFPA 80. Extend astragal beyond edge of door on which astragal is mounted as required to comply with published listing.

C. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Welded Frames: Weld continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
3. At postinstalled expansion type anchors, provide countersunk screws.
    a. Dimple holes in frames for countersinking of screws to allow filling and finishing for flush appearance after painting.
4. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor. Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
    a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on center and as follows:
        i) Three anchors per jamb up to 60 inches in frame height.
        ii) Four anchors per jamb from 60 to 90 inches in frame height.
        iii) Five anchors per jamb from 90 to 96 inches in frame height.
        iv) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in frame height.
        v) Two anchors per head for frames more than 42 inches wide and mounted in stud partitions.

b. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches on center, to match coursing, and as follows:

i) Two anchors per jamb up to 60 inches in frame height.

ii) Three anchors per jamb from 60 to 90 inches in frame height.

iii) Four anchors per jamb from 90 to 120 inches in frame height.

iv) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in frame height.

c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches on center.

6. Door Silencers: Except on weather-stripped and gasketed frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

7. Terminated Stops: Terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory-prepare hollow-metal doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to SDI A250.6, the Door Hardware Schedule and templates furnished as specified in Section 08 71 00 “Door Hardware.”

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal doors and frames for hardware.

3. Where installing doors in existing frames, field verify locations and spacing of hinges and strike.

F. Glazed Lites: Provide fixed moldings and removable stops around glazed lites. Form corners of stops and moldings with mitered hairline joints.

1. Provide fixed moldings and removable stops such that each glazed lite is capable of being removed independently.

2. At hollow-metal doors, provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.

3. Provide fixed frame moldings on exterior side of exterior doors and frames, and secure side of interior doors and frames. Provide removable stops on interior side of exterior doors and frames, and non-secure side of interior doors and frames.

4. Coordinate rabbet width between fixed and removable stops with type of glazing and installation types indicated.

5. Provide removable stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches on center, and not more than 2 inches on center from each corner.

2.8 STEEL FINISHES

A. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

B. Uncoated Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, “Solvent Cleaning”; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, “Power Tool Cleaning,” or SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

C. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.

1. Shop Primer: Manufacturer’s standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer’s written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed work.
    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch up finishes.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Secure with postinstalled expansion anchors.
    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors in dimpled openings, and fill and make smooth, flush, and invisible on exposed faces after painting.
4. Solidly pack mineral-fiber insulation inside frames where indicated.
5. Installation Tolerances: Adjust hollow-metal frames for squareness, alignment, twist, and plumb to the following tolerances:
    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Hollow-Metal Doors: Comply with SDI A250.8.
2. Fire-Rated Hollow-Metal Doors: Install doors with clearances according to NFPA 80.
3. Smoke Control Hollow-Metal Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 81 00 “Glass Glazing” and with hollow-metal door and frame manufacturer’s written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches on center, and not more than 2 inches from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal doors or frames that are warped, bowed, or otherwise unacceptable.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying rust-inhibitive primer.

END OF SECTION 08 11 13

SECTION 08 33 13

OVERHEAD COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following overhead coiling counter door types:

1. Non-fire-rated, manually-operated.

B. Related Sections include:

1. Section 05 50 00 “Metal Fabrications” for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.3 REFERENCES

A. ASTM International:

1. ASTM A480: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
2. ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A666: Standard Specification for Annealed or Cold-Worked Austentic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. California Building Code (CBC) – California Code of Regulations, Title 24, Part 2.

C. International Organization for Standardization (ISO):

1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).

D. National Association of Architectural Metal Manufacturers/National Ornamental & Miscellaneous Metals Association (NAAMM/NOMMA):

1. NAAMM/NOMMA 500: Metal Finishes Manual for Architectural and Metal Products.

E. Underwriters Laboratory (UL):

1. UL 10B: Standard for Fire Tests of Door Assemblies.
2. UL 325: Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

3. UL 1784: Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling counter door and accessory.
   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and finished accessories.
   3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding weights, and static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, and other accessories.
   6. Show mounting arrangement of motors.
   7. Include electrical power requirements, and diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors available for units with factory-applied finishes, for selection by Architect.

D. Samples for Verification: For each type of exposed finish and color required for the following components, in manufacturer's standard sizes:
   1. Curtain slats.
   2. Bottom bar.
   3. Guides.
   4. Hood.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: for Installer

B. Sample Warranty: For special warranties.

C. Field quality-control test and inspection reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling counter doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than 2 hours' normal travel time from Installer's place of business to Project site.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of overhead coiling counter doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which powder-coat finish deteriorates or otherwise fails in materials or workmanship with specified warranty period. Deterioration includes color fading, chalking, cracking, checking, and peeling or failure of paint to adhere to metal substrate.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling counter door assemblies through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Loads: Overhead coiling counter doors shall withstand the effects of the following, without evidencing permanent deformation or disengagement of door components, and as required to remain operable under loads, both inward and outward:

1. Wind loads and stresses, acting inward and outward, calculated based on requirements of the California Building Code, using factors defined therein and applicable to local site conditions and specific project parameters.

a. Wind Speed (Ultimate Design Wind Speed V_{ult}): 115 mph.

B. Seismic Performance: Overhead coiling counter door assemblies shall withstand the effects of earthquake motions calculated according to requirements of the California Building Code and Seismic Design Category specific to project.

C. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-

protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Smoke- and Draft-Control Assemblies: Provide assembly with gaskets listed and labeled with the letter “S” on the fire-rating label for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 OVERHEAD COILING COUNTER DOOR (NON-FIRE-RATED)

A. Overhead Coiling Counter Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Clopay Building Products; Model CESC10.
   b. CornellCookson, Inc.; Model ESC10.
   c. Overhead Door Corporation; Model 651.
   d. Equal product in accordance with Division 1 requirements for product substitutions.

B. Operation Cycles: Door components and operators capable of operating for not less than 50,000 cycles. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Weight of Insulated Overhead Coiling Door Curtain: 2.8 lbs per square foot maximum.

D. Door Curtain Material: Stainless-steel.

E. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.

F. Bottom Bar: Manufacturer’s standard continuous channel or tubular shape, to match curtain slat material and finish.

G. Curtain Jamb Guides: Stainless-steel with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish.

1. Shape: Square
2. Mounting: Face of wall.

I. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Locking bars, operable from inside with thumbturn, and outside with cylinder.

J. Manual Door Operator: Manufacturer's standard crank operator.

1. Provide operator with manufacturer's standard removable operating arm.

K. Door Finish:

1. Stainless-Steel Finish: ASTM A480, No. 4 (polished directional satin).

2.4 MATERIALS, GENERAL

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.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Stainless-Steel Door Curtain Slats: ASTM A666, Type 304; sheet thickness of 0.038 inch (20 gage) minimum; and as required.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Stainless-Steel: 0.025-inch-thick (24 gage), stainless-steel sheet, Type 304, complying with ASTM A666.

2.7 LOCKING DEVICE

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Standard with manufacturer, and keyed to building keying system.

a. Keys: Two for each cylinder.

2. Safety Interlock Switch: Equip motorized doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

B. Metal Trim at Wall Opening and Jamb Guides: Sheet metal matching material and finish of hood.

1. Thickness: 0.060 inch (16 gage) minimum.

2.9 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in/ft of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATOR

A. General: Equip overhead coiling counter door with manual door operator by door manufacturer.

B. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf force to turn crank. Fabricate gearbox to be oiltight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: ASTM A480, No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling counter doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling counter doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and furnish reports.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test door release, closing, and alarm operations when activated by building's fire alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.

2. Inspect fire-rated overhead coiling counter doors in accordance with NFPA 80.

C. Repair or adjust installations where inspections indicate they do not comply with specified requirements.

D. Reinspect repaired or adjusted installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling counter doors.

END OF SECTION 08 33 13

SECTION 08 62 50
TUBULAR DAYLIGHTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tubular daylighting devices and accessories.

1.2 RELATED SECTIONS

A. Section 07510 - Built-Up Bituminous Roofing: Flashing of skylight base.

B. Section 07520 - Modified Bituminous Membrane Roofing: Flashing of skylight base.

C. Section 07530 - Electrometric Membrane Roofing: Flashing of skylight base.

D. Section 07540 - Thermoplastic Membrane Roofing: Flashing of skylight base.

E. Section 07600 - Flashing and Sheet Metal: Metal curb flashings.

F. Section 15810 - HVAC Air Distribution: Fan vent duct and connections.

G. Section 16570 - Integrated Automation Facility Controls: Lighting controllers.

H. Section 16150 - Common Work Results Electrical: Power cable, power supply and electrical connections.

I. Section 16500 - Lighting Equipment and Controls: Control cable, dimming controls, light bulbs and lamps.

1.3 REFERENCES

A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM A 463/A 463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process.

D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process.

E. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

F. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.

G. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

H. ASTM E 308 - Standard Practice for Computing the Colors of Objects by Using the CIE System.

I. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors.

J. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference.

K. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

L. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane.

M. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.

N. ASTM D 1929 - Test Method for Ignition Properties of Plastics.

O. ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.

P. ASTM F 1642 - Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading.

Q. ASTM F 2912 - Standard Specification for Glazing and Glazing Systems Subject to Airblast Loading.

R. AAMA/WDMA/CSA 101/I.S.2/A440 - Standard/Specification for Windows, Doors, and Unit Skylights; 2011

S. FM Standard 4431 - The Approval Standard for Skylights

T. UL 2108 - Low Voltage Lighting Systems

U. GSA-TS01-2003: Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings

V. Unified Facilities Criteria (UFC) 4-010-01, Change October 2013, DoD Minimum Antiterrorism Standards for Buildings,

W. CSA C22.2 No. 250.0 - Luminaires.

X. ICC-ES AC-16 - Acceptance Criteria for Plastic Skylights; 2008.

Y. IBC Section 1710 - Load Test Procedure for Wind Load Testing on Rooftop Daylight Collecting System - Structural Performance Testing - Devised by ATI PE); 2012

Z. IBC Section 2606.7.2 - Installation - Diffuser Fall Out Test (Devised by PE); 2012

AA. OSHA 29 CFR - 1910.23 (e)(8) (Guarding Requirements for Skylights); 1926 Subpart M (Fall Protection); 1926.501(b)(4)(i); 1926.501(i)(2); 1926.501(b)(4)(ii)

BB. California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1)

1.4 PERFORMANCE REQUIREMENTS

A. Daylight Reflective Tubes: Spectralight Infinity with INFRAREDuction Technology combines ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance. Patented spectrally-selective optical surface yields an average total- and specular-reflectance greater than 99.5% percent for the Visible Light spectrum (400 nm to 700 nm) providing maximized visible light transmission and less than 25% reflectance for Infrared (IR) heat wavelengths (750 nm to 2500 nm) for minimized heat transmission, resulting in a spectrally-selective Total Solar Spectrum (250 nm to 2500 nm) reflectance less than 37 percent, as measured using a Perkin Elmer Lambda 1050 spectrophotometer with a Universal Reflectance Accessory. Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.

B. SOLAMASTER 750 DS-O / 750 DS-C (OPEN/CLOSED CEILING)
   1. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG70, size tested 21 inch (533 mm) diameter, Type TDDOC and Type TDDCC.
      a. Air Infiltration Test:
         1) Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
      b. Water Resistance Test:
         1) Passes water resistance; no uncontrolled water leakage with a pressure differential of 10.7 psf (512 Pa) or 15 percent of the design load (whichever is greater) and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ASTM E 547 and ASTM E 331.
      c. Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
         1) No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 70 psf (3.35 kPa).
   2. Fire Testing:
      a. Fire Rated Roof Assemblies:
         1) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code for Class A, B, and C roof assemblies.
      b. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code.
      c. Self-Ignition Temperature - Greater than 650 degrees F per ASTM D-1929.
      d. Smoke Density: Rating no greater than 450 per ASTM E 84 in way intended for use. Classification C.
      e. Rate of Burn and/or Extent: Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2 per ASTM D 635.
      f. Rate of Burn and/or Extent: Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D 635.
   3. Fall Protection Performance:
      a. Passes fall protection test: No penetration of dome or curb cap when subject to 400 lb (160 Kg)/42 inch (1066 mm) impact drop test when tested in accordance with OSHA 29 CFR 1926.506(c) Safety Net Systems.

b. Passes fall protection test: California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1) Skylight Screens.

4. Blast Resistance: ASTM F1642, ASTM F2912, GSA-TS01-2003, and UFC 4-010-01:
   a. Airblast Loading ASTM Hazard Rating: Passes: No Hazard Rating
   b. Airblast Loading UFC Level of Protection: Passes Medium Level of Protection
   c. Dynamic Overpressure Loading ASTM Hazard Rating: Passes: No Hazard Rating
   d. Dynamic Overpressure Loading UFC Level of Protection: Passes Medium Level of Protection

1.5 SUBMITTALS

A. Submit under provisions of Section 01300 [01 30 00].

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Data sheets showing roof dome assembly, flashing base, reflective tubes, diffuser assembly, and accessories.
   4. Installation requirements.

C. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including rough opening and framing dimensions, anchorage, roof flashings and accessories.

D. Electrical wiring diagrams and recommendations for power and control wiring.

E. Verification Samples: As requested by Architect.

F. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engaged in manufacture of tubular daylighting devices for minimum 20 years.

B. Installer Qualifications: Installer must be a factory-trained and certified Solatube Commercial installer prior to installation. Product shall be installed by a factory-trained and certified Solatube Commercial installer. For a list of qualified installers please contact Taylor Mason Tel: 310.357.3270 tmason@solatube.com (commsales@solatube.com)

1.7 DELIVERY, STORAGE, AND HANDLING

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

B. Store products in manufacturer's unopened packaging until ready for installation.

1.8 PROJECT CONDITIONS

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

1.9 WARRANTY

A. Daylighting Device: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Solatube International, Inc., which is located at: Solatube International 2210 Oak Ridge Way; Vista, CA 92081-8341; Kim Cahners Tel: (310) 415-3177; Tel: 760-477-1120; Fax: 760-597-4488; Email: request info (kcahners@solatube.com); Web:www.solatube.com or Approved Equal

2.2 TUBULAR DAYLIGHTING DEVICES

A. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.

B. SolaMaster Series: Solatube Model 750 DS, 21 inch (530 mm) Daylighting System:
   1. Model:
      a. Solatube Model 750 DS-C Closed (Penetrating) Ceiling. AAMA Type TDDCC.
   2. Capture Zone:
      a. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
         1) Outer Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
            a) Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
      b. Tube Ring: 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC. Prevents thermal bridging between base flashing and tubing and channel condensed moisture. Attached to base of dome ring with butyl glazing rope 0.24 inch (6 mm) diameter; to minimize air infiltration.
      c. Dome Seal: Adhesive backed weatherstrip, 0.63 inch (16 mm) tall by 0.28 inch (7 mm) wide.
   3. Flashings:
      a. Roof Flashing Base:
         1) One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A792/A 792M, 0.028 inch (0.7 mm) plus or minus .006 inch (.015 mm) thick.
            a) Base Style: Type FC, Curb cap, with inside dimensions of 27 inches by 27 inches (685 mm by 685 mm) to cover curb as specified in Section 07600.
      b. Flashing Options:
         1) Curb Cap Insulation: Type CCI, Nominal 1 inch thick thermal insulation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6 (OFxft2xhr/Btu) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, & HFC free

blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4); Attic ventilation may be required per IBC 1203.2(OFxft2xhr/Btu). For use with Flashing Type FC.

2) Curb to be provided by manufacturer

4. Transfer Zone:
   a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209.
      1) Reflective Tubes:
         a) Reflective extension tube, Type EXX and Type EL with total length of run as indicated on the Drawings.
         b) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
      2) Tube Options
         a) Extension Tube Angle Adapter: Provide manufacturer's standard adapters for applications requiring:
            1) Type A2 two 0 to 90 degree extension tube angle adapters.
         b) Top Tube Angle Adapter and Bottom Tube Angle Adapter Kit: Type AK, Reflective 45 degree adjustable top and bottom angle adapters (one each), 16 inches (406 mm) long
5. Delivery Zone:
   a. Diffuser Assemblies for Tubes Penetrating Ceilings: Solatube Model 750 DS-C. Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches (605 mm by 605 mm) square frame to fit standard suspended ceiling grids or hard ceilings.
      1) Metal Transition Box: Type TM, Metal Round to Square transition box comprised of Spectralight Infinity SoftLight material with structured finish on exposed reflective surface, .015 in (0.4 mm) thick. Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
      2) Lens: Type L1, OptiView Fresnel lens design to maximize light output and diffusion with extruded aluminum frame and EPDM foam seal to minimize condensation and bug, dirt and air infiltration per ASTM E 283. Visible Light Transmission shall be greater than 90 percent at 0.022 inch (0.6 mm) thick. Classified as CC2.
      3) Supplemental Natural Effect Lens Type LN, Lens made of acrylic, classified as CC2, Class C, 0.060 inch (1.5 mm) thick, with open cell foam seal to minimize condensation and bug, dirt and air infiltration per ASTM E 283.
   b. Delivery Zone Options:
      1) Lighting Control System: Provide an electrical actuator controller, auxiliary switch(s), and cable as specified in Section 25 50 00; Common Work Results Electrical Section 26 05 00; and Lighting Equipment and Controls Section 26 50 00.
         a) Low Voltage Daylight Dimmer: Type D1, is an Electro-mechanically actuated daylight valve; 0-10 V Control, Class-2, UL Listed. Low voltage Daylight Dimmer electrical actuator provides for programmable (0 to 10VDC) scene-based dimming control for daylight output between 2 and 100 percent, auxiliary 12VDC dimming control for daylight output between 2 and 100 percent, or auxiliary

ON/OFF control. Input voltage: 24VAC at 50 or 60 Hz.

1) Programmable (0 to 10VDC) Control: requires an electrical actuator controller or building automation controller capable of producing a signal between 0 and +10 VDC (Min 50mA) to incrementally modulate up to 50 daisy chained Daylight Dimmers (Current Sinking) between fully closed at 0 to 1 volts to fully open at 9 to 10 volts.
2) Auxiliary 12VDC Dimming Control: requires 12VDC Dimming Switch (Current Sourcing; 12VDC power supply not required).
3) Auxiliary ON/OFF Control: requires commercial or residential single pole electric light switch.

b) Power can be transformed from line voltage through use of a UL Listed Class-2, 24VAC Transformer.

6. Accessories
   a. Optional Low-voltage Transformer: Solatube Remote Transformer, Type TR96, is a 96VA, 24VAC, 50/60HZ, UL Listed, UL Category XOKV7, CE Marked, Class-2 Transformer with cover plate mounting system configured for easy field assembly onto standard 4.06-in x 4.06-in (103mm x 103mm) square junction box: Inherently Limited, Primary: 120VAC, 240VAC, 277VAC and 480VAC. For use with Daylight Dimmer Type D1 only.
7. Catalog Number: S750DS-C-DA-FC-CCI-AK-EXX-A2-TM -L1-LN-D1-TR96

2.3 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.

B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions.

C. If substrate and rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Coordinate requirements for power supply, conduit and wiring.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

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

B. Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly and that finished installation is weather tight.
   1. Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
   2. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
   3. Coordinate attachment and seal of perimeter air and vapor barrier material.

C. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer

D. Align device free of warp or twist, maintain dimensional tolerances.

E. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.

F. Inspect installation to verify secure and proper mounting. Test each fixture to verify operation, control functions, and performance. Correct deficiencies.

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.
   2. Cylinders for door hardware specified in other Sections.
   3. Door silencers installed on hollow-metal steel frames.

B. Related Sections include:
   1. Section 08 11 13 “Hollow-Metal Doors and Frames” for hollow-metal steel doors and frames to receive door hardware, and for astragals provided as part of labeled fire-rated assemblies.
   2. Section 09 22 16 ”Cold-Formed Non-Structural Metal Framing” for concealed non-structural metal stud backing for support of doorstops and other wall-mounted hardware items.

1.3 REFERENCES

A. ASTM International (American Society for Testing and Materials):
   1. ASTM E 283: Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Wall, and Doors Under Specified Pressure Differences Across the Specimen.

B. Builders Hardware Manufacturers Association (BHMA):
   1. BHMA A156.1: Butts and Hinges.
   2. BHMA A156.2: Bored and Preassembled Locks & Latches.
   3. BHMA A156.3: Exit Devices.
   4. BHMA A156.4: Door Controls – Closers.
   5. BHMA A156.5: Auxiliary Locks and Associated Products.
   6. BHMA A156.6: Architectural Door Trim.
   7. BHMA A156.8: Door Controls – Overhead Stops and Holders.
   8. BHMA A156.13: Mortise Locks & Latches Series.
   9. BHMA A156.14: Sliding & Folding Door Hardware.
   10. BHMA A156.15: Release Devices – Closer Holder, Electromagnetic and Electromechanical.

11. BHMA A156.16: Auxiliary Hardware.
12. BHMA A156.17: Self-Closing Hinges & Pivots.
13. BHMA A156.18: Materials and Finishes.
14. BHMA A156.21: Thresholds.
15. BHMA A156.22: Door Gasketing and Edge Seal Systems.
16. BHMA A156.26: Continuous Hinges.
17. BHMA A156.28: Recommended Practices for Keying Systems.

C. Door and Hardware Institute (DHI):
1. DHI Handbook: Sequence and Format for the Hardware Schedule.
2. DHI Handbook: Recommended Locations for Architectural Hardware for Flush Wood Doors.

D. Hollow Metal Manufacturers Association (HMMA):
1. HMMA 831: Recommended Hardware Locations for Custom Hollow Metal Doors and Frames.

E. National Fire Protection Association (NFPA):
1. NFPA 70: National Electrical Code.
2. NFPA 80: Fire Doors and Fire Windows.
3. NFPA 101: Life Safety Code.
4. NFPA 105: Standard Practice for the Installation of Smoke Door Assemblies and Other Opening Protectives.
5. NFPA 252: Methods of Fire Tests of Door Assemblies.

F. Steel Door Institute (SDI):
1. ANSI/SDI A250.6: Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
2. ANSI/SDI A250.8 (Formerly SDI-100): Recommended Specifications for Standard Steel Doors and Frames.

G. Underwriters Laboratory (UL):
1. UL 10C: Positive Pressure Fire Tests of Door Assemblies.
2. UL 305: Panic Hardware.
3. UL 1784: Air Leakage Tests for Door Assemblies.

H. United States Department of Justice:
1. 2010 ADA Standards for Accessible Design.

1.4 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Installation Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Coordinate sizes and locations of concealed framing and blocking to ensure that doorstops and other wall-mounted items have sufficient backing as required for proper performance.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: Submit minimum 2-inch by 4-inch plate Samples of each type of finish required, except primed finish.

1. Submit full size Sample of exposed door hardware of each type as directed by Architect in specified finish. Tag with full description for coordination with door hardware sets. Submit Samples before, or concurrent with, submission of final door hardware sets.

a. Full size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

C. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit final door hardware sets at earliest possible date, particularly where approval of door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

2. Format: Comply with scheduling sequence and vertical format in DHI Handbook "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page. Use same door numbers as in Contract Documents.

3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.

b. Location of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

c. Type, style, function, size, quantity, and finish of each door hardware item.

d. Complete designations, including name and manufacturer, type, style, function, size, quantity, and finish of each door hardware product.

e. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

i) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

f. Fastenings and other pertinent information.

g. Explanation of abbreviations, symbols, and codes contained in schedule.

h. Mounting locations for door hardware.

i. List of related door devices specified in other Sections for each door and frame.

4. Existing Conditions: Where new hardware is indicated to be installed on existing doors, frames, or openings, or existing hardware is indicated to be removed and reinstalled, field verify all existing conditions. Notify Architect of any conditions that would prevent installation of scheduled hardware as required for proper operation and normal maintenance.

a. Indicate date of project site visit on submittal. Submittals prepared without project site visit for field verification will be returned as non-compliant.

D. Keying Schedule: Prepared by or under supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

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

D. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Installer shall have warehousing facilities in Project's vicinity.

2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1. Architectural Hardware Consultant shall also be a certified Electrified Hardware Consultant.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Keying Conference: Conduct conference at Project site to comply with Division 1 requirements for project meetings. In addition to Owner, Construction Manager, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant ***[and Owner's security representative or consultant]***. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Requirements for access control.
5. Address for delivery of keys.

E. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials. Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.10 FIELD CONDITIONS

A. Existing Openings: Where new hardware components are scheduled for installation on existing construction or where modifications to existing door hardware is required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper door operation and maintenance. Refer to requirements for installation of new hardware on existing doors, frames, and opeingings in “Action Submittals” Article.

1.11 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including excessive deflection, cracking, or breakage.
    b. Faulty operation of doors and door hardware.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Periods:
    a. Locksets (non-electrified): 3 years from date of Substantial Completion.
    b. Surface Closers: 10 years from date of Substantial Completion.
    c. Exit Devices: 3 years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner’s continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

C. Means of Egress Doors: Comply with NFPA 101. Locks do not require use of a key, tool, or special knowledge for operation. Latches do not require more than 15 lbf to release the latch.

D. Accessibility Requirements:

1. Comply with applicable provisions of the following:

a. California Building Code (Title 24, Part 2), Chapters 11A and 11B.

b. United States Department of Justice's 2010 ADA Standards for Accessible Design.

2. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

3. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.

c. Exterior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

d. Fire Doors: Minimum opening force allowable by authorities having jurisdiction, but not to exceed 15 lbf.

4. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

5. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

2.2 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturer's products.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Manufacturer and product designation are listed for each door hardware type required. Manufacturer's names are abbreviated in Part 3 "Door Hardware Sets" Article.

2.3 HINGES

A. Butts and Hinges: BHMA A156.1, Grade 1.

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.

2. Wood Screws: For wood doors and frames.

3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors; wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.4 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17, Grade 1.

2.5 CENTER-HUNG AND OFFSET PIVOTS

A. Center-Hung and Offset Pivots: BHMA A156.4, Grade 1.

2.6 CONTINUOUS HINGES

A. Standard: BHMA A156.26, Grade 1.

B. Continuous Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves; joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

2.7 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As scheduled in Part 3 “Door Hardware Sets” Article.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
3. Deadbolts: Minimum 1-inch latchbolt throw.

C. Strikes: Provide manufacturer’s standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

D. Bored Locks: BHMA A156.2.

E. Mortise Locks: BHMA A156.13.

2.8 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.5; with strike that suits frame.

B. Mortise Auxiliary Locks: BHMA A156.5; with strike that suits frame.

2.9 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16, Grade 1; minimum 3/4-inch throw; designed for mortising into door edge.

B. Dustproof Strikes: With 3/4-inch-diameter, spring-tension plunger.

2.10 EXIT DEVICES

A. Exit Devices: BHMA A156.3, Grade 1.

B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

D. Removable Mullions: BHMA A156.3.

E. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

F. Outside Trim: As scheduled in Part 3 “Door Hardware Sets” Article.

2.11 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5, Grade 1.

B. Cylinders: Manufacturer’s standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Six.
2. Bored-Lock Type: Cylinders with tailpieces to suit locks.

C. Permanent Cores: Manufacturer’s standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturer’s cylinders.

D. Construction Keying: Comply with the following:

1. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
    a. Replace construction cores with permanent cores as directed by Owner.

E. Manufacturer: Same manufacturer as for locks and latches.

2.12 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. Comply with all keying requirements of Owner.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the notation “DO NOT DUPLICATE.”
2. Quantity: In addition to one extra key blank for each lock, provide the following (as applicable):
    a. Cylinder Change Keys: ***[Three]***.
    b. Master Keys: ***[Five]***.
    c. Grand Master Keys: ***[Five]***.

d. Great-Grand Master Keys: ***[Five]***.

2.13 OPERATING TRIM

A. Operating Trim: BHMA A156.6.

2.14 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.

B. Astragals: BHMA A156.22.

2.15 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4, Grade 1; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Install surface closer on non-public side of door unless indicated otherwise.

a. Provide parallel arm closers when located on push-side of door.

B. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.

2.16 CONCEALED CLOSERS

A. Concealed Closers: BHMA A156.4, Grade 1; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

B. Concealed-in-Door Closer: Mortised into top rail of minimum 1-3/4-inch-thick doors and track mortised into head frame; with double lever arm indicated.

C. Concealed Overhead Closer: Mortised into head frame; with cast-metal body and exposed cover plate.

D. Concealed Floor Closer: With cement case and cast-iron closer body case and top pivot.

1. Floor Plates: Provide [flush cover plates matching door hardware finish unless thresholds are indicated] [recessed floor plates with insert of floor finish material and extended closer spindle to accommodate thickness of floor finish material].

2.17 CLOSER HOLDER RELEASE DEVICES

A. Closer Holder Release Devices: BHMA A156.15, Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by building fire alarm system.

2.18 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.19 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.

2.20 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

2.21 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Door Sweeps: Gasket material held in place by flat metal housing or flange; surface mounted to face of door with screws.

C. Door Shoes: Gasket material held in place by metal housing; mounted to bottom edge of door with screws.

D. Automatic Door Bottoms: Gasket material held in place by metal housing that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

2.22 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.23 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch thick metal as scheduled in Hardware Sets; with manufacturer’s standard machine or self-tapping screw fasteners.

B. Kickplates: Height as scheduled in Part 3 “Door Hardware Sets” Article, by door width with allowance for frame stops.

2.24 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16; Grade 1.

B. Silencers for Metal Door Frames: Neoprene or rubber; minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.25 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Wood or Machine Screws: For the following:
    a. Hinges mortised to doors or frames.
    b. Strike plates to frames.
    c. Closers to doors and frames.
3. Steel Through Bolts: For the following unless door blocking is provided:
    a. Surface hinges to doors.
    b. Closers to doors and frames.
    c. Surface-mounted exit devices.
4. Spacers or Sex Bolts: for through bolting of hollow-metal doors.
5. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
6. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.26 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware sets.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before stripping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Verify concealed blocking and backing has been installed for all doorstops and other wall-mounted items occurring on framed walls.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Operating Hardware: Between 30 inches and 44 inches above finish floor, per 2019 California Building Code Section 1133B.2.5.2.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in Part 3 "Door Hardware Sets" Article, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying schedule.

[or]

2. Owner's locksmith will replace construction cores with permanent cores.

a. Construction cores to be returned to Contractor.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 1 Section for demonstration and training.

3.7 DOOR HARDWARE SETS

A. Items listed in the following Schedule of Door Hardware Sets conform to requirements specified in Part 2 of this Section.

B. Manufacturer's Abbreviations:

GLY	Glynn-Johnson
HAG	Hager
IVE	Ives
LCN	LCN
PEM	Pemko
SCH	Schlage
STN	Stanley
TRI	Trimco/Builder's Brass Works
VON	Von Duprin

C. Hardware Sets:

Set: 1.0

Doors: 121A

1	Patch	As Required	US32D	GS
1	Pivot	PF-ADJ-PIVOT	US32D	GS
1	Locking Pull	LP3301FHD ADA FinSet1	US32D	GS
1	Concealed Closer	OHC-609-90NHO		GS
1	Door Stop	403/441H as required	US26D	RO

Set: 2.0

Doors: 116G

8	Hinge, Full Mortise	TA2314	US26D	MK
1	Self latching top bolt only - Metal door	2805	US26D	RO
1	Classroom Lock	LC 8237 LNL	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Coordinator	2600 x FB x Mtg Brkts	US28	RO
2	Surface Closer	8501	689	NO
2	Kick Plate	K1050 10" CSK BEV	US32D	RO
2	Door Stop	403/441H as required	US26D	RO
1	Astragal	357C		PE
2	Silencer	608-RKW		RO

Set: 3.0

Doors: 116D

4	Hinge, Full Mortise	TA2314 NRP	US26D	MK
1	Storeroom/Closet Lock	LC 8204 LNL	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Surface Closer	8501	689	NO
1	Wall Stop	403	US26D	RO
3	Silencer	608-RKW		RO

Set: 4.0

Doors: 108E

1	Note	all hardware by door manufacturer		OT

Set: 5.0

Doors: 116BB, 166BA

8	Hinge, Full Mortise	TA2314 NRP	US26D	MK
1	Flush Bolt	555	US26D	RO
1	Classroom Lock	LC 8237 LNL	US32D	SA
1	Cylinder	Match Facility Standard		OT
2	Surf Overhead Stop	10-336	689	RF
1	Astragal	357C		PE
2	Silencer	608-RKW		RO

END OF SECTION 08 71 00

SECTION 08 81 00

GLASS GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Glass for the following glazed systems:
      a. Aluminum entrance and storefront systems.
      b. Hollow-metal doors and frames.
   2. Glazing sealants and accessories.

B. Related Sections include:
   1. Section 08 11 13 "Hollow-Metal Doors and Frames" for hollow-metal steel window frames and doors to receive glazing.
   2. Section 08 41 13 "Glazed Aluminum Entrances and Storefronts" for aluminum storefront and entrance systems to receive glazing.
   3. Section 08 87 00 "Glazing Surface Films" for surface-applied glazing films.
   4. Section 08 88 13 "Fire-Rated Glazing" for fire-protection-rated glazing for fire-protection-rated openings, and fire-resistant-rated glazing for fire-resistant framing systems.

1.3 REFERENCES

A. American Architectural Manufacturer's Association (AAMA):
   1. AAMA GDSG-1: Glass Design for Sloped Glazing.
   2. AAMA TIR-A7: Sloped Glazing Guidelines.
   3. AAMA 800: Voluntary Specifications and Test Methods for Sealants.

B. ASTM International:
   1. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
   2. ASTM C 1021: Standard Practice for Laboratories Engaged in the Testing of Building Systems.
   3. ASTM C 1036: Standard Specification for Flat Glass.
   4. ASTM C 1048: Standard Specification for Heat-Treated Flat Glass – Kind HS, Kind FT, Coated, and Uncoated Glass.
   5. ASTM C 1087: Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
   6. ASTM C 1172: Standard Specification for Architectural Laminated Flat Glass.

7. ASTM C 1281: Standard Specification for Preformed Tape Sealants for Glazing Applications.
8. ASTM E 1300: Standard Practice for Determining Load Resistance of Glass in Buildings.
9. ASTM C 1330: Standard Specification for Cylindrical Sealant Backing For Use With Cold Liquid-Applied Sealants.
10. ASTM E 2190: Standard Specification for Insulating Glass Unit Performance and Evaluation.

C. California Building Code (CBC) – California Code of Regulations, Title 24, Part 2.

D. California Department of Public Health (CDPH):
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

E. Code of Federal Regulations (CFR):
1. 16 CFR 1201: Safety Standard for Architectural Glazing Materials.
2. 40 CFR, Part 59, Subpart D: National Volatile Organic Compound Emission Standards.

F. Glass Association of North America (GANA):
1. Glazing Manual.
2. Laminated Glazing Reference Manual.

G. Insulating Glass Certification Council (IGCC).

H. Insulating Glass Manufacturer's Alliance (IGMA):
1. IGMA TB-3001: Guidelines for Sloped Glazing.
2. SIGMA TM-3000: North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

I. Lawrence Berkeley National Laboratory (LBNL):
1. WINDOW 5.2 computer program.

J. National Fenestration Rating Council (NFRC):
1. NFRC 100: Procedure for Determining Fenestration Product Thermal Properties.
2. NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.
3. NFRC 300: Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
4. NFRC CAP 1: Certification Agency Program.

K. National Glass Association (NGA):
1. Certified Glass Installer Program.

L. Safety Glazing Certification Council (SGCC).

M. South Coast Air Quality Management District (SCAQMD):

1. Rule 1168 – Adhesive and Sealant Applications.

1.4 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

D. VOC: Volatile Organic Compound.

1.5 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.7 ACTION SUBMITTALS

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

B. Samples for Verification: For the following products, in the form of 12-inch square Samples for glass.
1. Each type of laminated glass.
2. For each color (except black) of exposed glazing sealant indicated.

C. Glazing Accessory Samples: For each color of exposed gaskets and glazing sealants, in 12-inch lengths.

D. CALGreen Submittals:
1. Manufacturer's product data for glazing sealants and primers indicating compliance with product requirements specified in "CALGreen Requirements" Article.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installers.
2. Manufacturers of insulating-glass units with sputter-coated, low-e coatings.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: For tests performed by a qualified testing agency, for the following:
1. Tinted glass.
2. Insulating glass.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance***[; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program]***.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test not fewer than ***[four]*** Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.12 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or are below 40 deg F.

1.13 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Provide glazing sealants and primers which comply with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule 1168, except as noted otherwise below. Such products shall also comply with Rule 1168 prohibition of the use of certain toxic compounds (chloroform, ethylene, dichloride, methylene chloride, perchloroethylene, and trichloroethyelen).

2.3 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Engage a qualified professional engineer to confirm that indicated glass thicknesses are capable of withstanding loads within limits and under conditions determined in accordance with California Building Code and ASTM E 1300.

1. Probability of Breakage:
    a. Glazing Not More Than 15 Degrees From Vertical Plane: Not greater than 8 lites per 1000.
        i) Load Duration: 3 seconds.
    b. Sloped Glazing More Than 15 Degrees From Vertical: Not greater than 1 lite per 1000.
        i) Load Duration: 30 days.
2. Maximum Lateral Deflection: Not more than that required to maintain glazing edge support.

C. Safety Glazing: Where tempered or laminated glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For laminated-glass lites, properties are based on products of construction indicated.

2.4 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Glazing Manual," and "Laminated Glazing Reference Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark safety glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction, or of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Glass Thicknesses: Glass thicknesses indicated are minimums. Provide glass that complies with specified performance requirements.

1. Thickness of Tinted Glass: Provide same thickness of tinted glass throughout project for each tint color indicated.

D. Strength: Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.5 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C 1048.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. Kind: Kind FT (fully tempered).
3. Condition: Comply with requirements for uncoated and coated glass as follows:
   a. Uncoated Vision Glass: Condition A.
   b. Coated Vision Glass: Condition C.
4. Type: Type I (transparent flat glass).
   a. Class:
      i) Where Clear Glazing is Indicated: Class 1 (clear).
      ii) Where Tinted Glazing is Indicated: Class 2 (tinted).
      -Tint Color: As indicated in Glass Schedules at end of this Section.
5. Quality: Q3.

2.6 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Glass Plies: Comply with applicable requirements in "Glass Products" Article.
3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
4. Interlayer Color: Clear except where indicated otherwise.

B. Laminated Glass Types: Refer to "Laminated Glass Schedule" at end of this Section.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Glazing Sealant: Single-component, nonsag, neutral-curing silicone glazing sealant; ASTM C 920, Type S, Grade NS, Class 50 minimum, Use NT (exposure), Use G, A, O (joint substrate)

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 795 Silicone Building Sealant.
   b. Momentive Performance Materials, Inc./GE; SCS2000 SilPruf.
   c. Pecora Corporation; 895.
   d. Tremco Incorporated; Spectrem 2.
   e. Equal product in accordance with Division 1 requirements for product substitutions.
2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
3. VOC Content: Complies with requirements specified in "CALGreen Requirements" Article.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below (AAMA standards referenced below are contained within AAMA 800):

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types (AAMA standards referenced below are contained within AAMA 800):

1. AAMA 810.1, Type I, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Framing System Glazing Stops and Gaskets:

1. Hollow-Metal Steel Frames: Refer to Section 08 11 13 ”Hollow-Metal Doors and Frames” for removable glazing stops.
2. Aluminum Storefront Systems: Refer to Section 08 41 13 ”Glazed Aluminum Entrances and Storefronts” for pressure-glazing system with gaskets.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, and then to jambs. Cover horizontal framing joints by applying tapes to jambs, and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant, where applicable.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work towards centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter-cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work towards centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than 4 work days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type G-1: Clear fully tempered float glass.

1. Thickness: 6.0 mm (±1/4 inch).
2. Provide safety glazing labeling.
3. Optical and Thermal Properties:
   a. Visible Light Transmittance: 89 percent.
   b. Solar Heat Gain Coefficient: 0.82 maximum.
   c. Shading Coefficient: 0.94.
   d. Winter Nighttime U-Factor: 1.02 maximum.
   e. Summer Daytime U-Factor: 0.93 maximum.

END OF SECTION 08 81 00

SECTION 09 05 65

CONCRETE MOISTURE-CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Concrete moisture-control system consisting of the following components, for interior concrete slabs to receive finish flooring materials:
    a. Epoxy-resin-based moisture-control coating.
    b. Cementitious overlay.
2. Preinstallation concrete moisture and alkalinity testing.

B. Related Sections include:

1. Division 1 Section for allowances, for procedural and administrative requirements for allowances for concrete moisture-vapor control system.
2. Division 1 Section for unit prices, for procedural and administrative requirements for unit prices for concrete moisture-vapor control system.
3. Section 03 05 05 ”Concrete Sealer” for clear sealing compound for application to exposed concrete without finish flooring.

C. Unit Prices: Owner may elect to ***[add to] [reduce]*** Contract Sum by way of Change order, based on needed scope of concrete moisture-control system as determined by concrete moisture testing. Refer to Division 1 Section “Unit Prices” for ***[additive] [deductive]*** costs for concrete moisture-control system.

D. Allowances: Portions of specified Allowance designated for concrete moisture-control system in Division 1 Section “Allowances” will be allocated based on needed scope determined by concrete moisture testing.

1.3 REFERENCES

A. ASTM International:

1. ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
2. ASTM C 150: Standard Specification for Portland Cement.
3. ASTM C 219: Standard Terminology Relating to Hydraulic Cement.
4. ASTM D 1308: Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
5. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials.
6. ASTM F 710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

7. ASTM F 2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
8. ASTM F 3010: Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

B. Code of Federal Regulations (CFR):
1. 40 CFR, Part 59, Subpart D: National Volatile Organic Compound Emission Standards.

1.4 DEFINITIONS

A. VOC: Volatile organic compounds.

1.5 COORDINATION

A. Coordinate sequencing of installation of concrete moisture-control system such that the length of time that system is left exposed prior to subsequent installation of finish flooring material is minimized. Protect system as specified in Part 3 “Protection” Article.

1.6 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site to review pertinent issues related to installation of concrete moisture-control system.
1. Attendees: Installer and representatives of concrete moisture-control system manufacturer, and other manufacturers and installers affected by installation of concrete moisture-control system.
2. Agenda: Review methods and procedures, and outstanding issues related to concrete moisture-control system including, but not limited to, the following:
a. Condition of substrate and preparatory work.
b. Project conditions.
c. Requirements for protecting work, including restriction of traffic during installation period.
d. Manufacturer’s installation instructions and warranty requirements.
e. Coordination with other work.
f. Protection of adjacent work.
3. Document proceedings including corrective measures and actions required, and furnish copy of record to each participant.

1.7 ACTION SUBMITTALS

A. Product Data: Manufacturer’s technical data for concrete moisture-control system:
1. Concrete moisture-control coating.
2. Cementitious overlay.

B. Concrete Moisture and Alkalinity Testing: Submit procedure and reporting format for moisture and alkalinity tests.

1.8 INFORMATIONAL SUBMITTALS

A. Installer's Qualification Data: Manufacturer's certification of Installer as approved installer of concrete moisture-control system.

1. Provide five project references.

B. Product Test Reports: From a qualified independent testing agency indicating concrete moisture-control coating compliance with specified performance requirements.

C. Concrete Moisture and Alkalinity Test Reports: Submit test reports with results of preinstallation testing for concrete moisture and alkalinity levels in concrete slabs, as specified in Part 3 "Concrete Moisture and Alkalinity Testing" Article.

D. Qualification Data: For testing agency.

E. Sample Warranties: For special warranties.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with minimum of 10 years experience in manufacturing non-silicate epoxy-based concrete moisture- and alkalinity-control products, with a record of successful in-service performance, and capable of providing field service representation during construction.

B. Installer Qualifications: Authorized representative trained and approved in writing by manufacturer of concrete moisture-control system components.

C. Testing Agency: Independent third-party agency with minimum of 5 years of demonstrated experience and capability to perform specified concrete moisture and alkalinity tests.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials in a dry, secure area protected from exposure to harmful weather conditions and at temperature levels as recommended by manufacturer.

1.11 FIELD CONDITIONS

A. Moisture Testing: Conduct preinstallation concrete moisture and alkalinity testing within temperature and relative humidity conditions as specified in Part 3 "Concrete Moisture and Alkalinity Testing" Article.

B. At new concrete slabs, do not install concrete moisture-vapor control system until preinstallation concrete moisture and alkalinity test results have been reviewed, and concrete slab has cured and is in acceptable condition as determined by manufacturer of concrete moisture-control coating.

1. Allow minimum curing time for concrete as recommended in writing by manufacturer of concrete moisture-control coating.

C. Environmental Limitations: Comply with concrete moisture-control system manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting system installation.

D. Close spaces to traffic during application of concrete moisture-vapor control system during application, and for not less than 24 hours afterwards, unless manufacturer recommends longer period.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer of concrete moisture-control coating agrees to replace finish flooring which fails due to concrete moisture emissions or alkalinity. Warranty coverage to be non-prorated, and is to include replacement of failed finish flooring, concrete moisture-control system, and all associated labor costs.

1. Failures include, but are not limited to, moisture, loss of adhesion, and mold and mildew.
2. Warranty shall not exclude the following:
    a. Cracks and other issues related to installation of concrete substrate.
    b. Upper limits for concrete moisture levels as recorded by preinstallation testing.
    c. Condensation or dew point issues.
    d. Salts in concrete.
    e. Pinholes in moisture-vapor control system.
    f. Future removal and reinstallation of finish flooring.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components and accessories of concrete moisture-control system through one source from same manufacturer, or as approved in writing by concrete moisture-control coating manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Permeability: Provide concrete moisture-control coating capable of forming a moisture-vapor barrier on surface of concrete slab with a maximum permeability of 0.10 perm, as tested per ASTM E 96.

2.3 CONCRETE MOISTURE-CONTROL COATING

A. Concrete Moisture-Control Coating: 100 percent-solids, two-component epoxy-resin-based, membrane-forming liquid coating designed for coating concrete substrates to restrict water-vapor emission passage and to provide protective barrier over alkaline surfaces; meeting requirements of ASTM F 3010; capable of meeting specified performance requirements and suitable for use over small hairline cracks and pinholes.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Ardex; MC Rapid.
    b. Koster American Corporation; VAP I 2000.

c. Mapei; Planiseal VS.

d. Equal product in accordance with Division 1 requirements for product substitutions.

2. VOC Content: Provide concrete moisture-control coating that complies with local regulatory limits for VOC content when calculated according to 40 CFR, Part 59, Subpart D (EPA Method 24).

3. Resistance to Alkalinity: No effect when exposed to14 pH alkali solution when tested according to ASTM D 1308 for acids/alkali.

4. Acrylic, latex, sodium, lithium, potassium silicate formulations, and other single-component products are not acceptable.

5. Three-component products which include water as a component are not acceptable.

2.4 CEMENTITIOUS OVERLAY

A. Cementitious Overlay and Patching Compound: Portland cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/8 inch and approved in writing by manufacturer of moisture-control coating.

1. Product: Subject to compliance with requirements, provide one of the following:

a. Ardex; K-15 Self-Leveling Underlayment Concrete.

b. Koster American Corporation; SL.

c. Mapei; Ultraplan 1 Plus.

d. Equal product in accordance with Division 1 requirements for product substitutions.

2. Cement Binder: ASTM C 150, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.

3. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

4. Underlayment Additive: Resilient-emulsion product of cementitious overlay manufacturer formulated for use with overlay when applied to substrate and conditions indicated.

5. Primer: Manufacturer's recommended primer to facilitate adhesion of cementitious overlay to surface of concrete moisture-control coating.

PART 3 - EXECUTION

3.1 CONCRETE MOISTURE AND ALKALINITY TESTING

A. Testing Agency: ***[Owner will engage] [Engage]*** a qualified independent testing and inspecting agency to perform moisture and alkalinity testing as specified in this Article.

B. Testing Conditions: Do not conduct moisture and alkalinity testing until final building environmental conditions have been achieved. Maintain temperature between 65 and 85 deg F, and relative humidity between 40 percent and 60 percent for not less than 72 hours prior to, and throughout duration of testing.

C. Prepare concrete slab substrates prior to testing in accordance with referenced testing standards.

1. Verify that substrates are dry and free of curing compounds, sealers, coatings, and other substances that would preclude accurate test readings.

D. Moisture Testing: Moisture testing shall be performed using relative humidity in-situ probe test method, conforming with ASTM F 2170.

1. Level of moisture to be determined and reported as relative humidity (RH).
2. After completion of testing, fill test probe holes with cementitious patching material.

E. Alkalinity Testing: Testing shall utilize a calibrated digital 1-14 wide range pH meter and conform with requirements of ASTM F 710 for test procedure. Paper and pencil type tests are not acceptable.

F. Quantity and locations of testing shall meet the following criteria.

1. Minimum of three tests for first 1,000 square feet.
2. Minimum of one test for each additional 1,000 square feet.
3. At slabs on grade, include at least one test within 3 feet of each exterior wall.

G. Test reports shall include the following information:

1. Name and address of structure.
2. Description of testing instruments and methods. Include statement of justification for type of test instruments used; include copy of ASTM F 2170 and ASTM F 710 testing protocols.
3. Date and time of measurements.
4. Name, title, and affiliation of individual performing measurements.
5. Floor plan with location of each test location clearly marked. Include the following information.
    a. Moisture Tests:
        i) Locations and depths of probe holes within the structure.
        ii) Relative humidity in each probe hole, to the nearest percent relative humidity.
        iii) Temperature in each probe hole to the nearest degree F.
        iv) Ambient air temperature, to the nearest degree F, and relative humidity to the nearest percent above each probe hole.
        v) Make, model, and last calibration date of instrument used to make measurements.
    b. Alkalinity Tests:
        i) Location of each test.
        ii) pH level of each test.
6. Any observations that might affect the interpretation of individual measurements such as standing water on the slab, wet coring operations, weather, or ventilating system operations.

3.2 EXAMINATION

A. Preinstallation Concrete Moisture and Alkalinity Testing: ***[Owner will engage] [Engage]*** a qualified testing agency to conduct preinstallation concrete moisture and alkalinity testing of existing concrete slabs as specified in “Concrete Moisture and Alkalinity Testing” Article, on all interior concrete slab areas to receive finish flooring.

1. Allow new concrete to cure for a minimum of ***[7]*** days.

2. After reviewing results of preinstallation concrete moisture and alkalinity testing of concrete slab areas to receive finish flooring, meet with ***[Architect] [and] [Construction Manager]*** to determine areas to receive moisture-control system.

3. Those slab areas that show moisture levels of less than 75 percent relative humidity, and a pH level of 7 to 9 need not be treated with concrete moisture-control system, and may be deducted from scope of work by way of Change Order, if so directed by ***[Architect] [Construction Manager]***.

[or]

4. Those slab areas that show moisture levels of more than 75 percent relative humidity, and a pH level of less than 7 or greater than 9 require application of concrete moisture-control system. Contract Sum may be adjusted accordingly ***[using accepted unit cost as a basis] [by allocating a portion of designated allowance]*** as directed by ***[Architect] [Construction Manager]***.

B. Examine concrete substrates, with Installer present, for compliance with requirements for installation of concrete moisture-control system. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Mask and protect adjacent surfaces from the effects of dust and splashing of materials associated with preparation and installation of concrete moisture-control system.

B. Surface Preparation: Scarify existing concrete slab surfaces to receive system treatment by shot blasting and as recommended in writing by manufacturer of moisture-vapor control coating. Acid etching is not allowed.

1. Comply with concrete moisture-vapor control coating manufacturer's written recommendations for surface profile roughness of concrete surface.

C. Crack and Joint Preparation: Mechanically open, vacuum, and seal all cracks and joints with moisture-control coating material, and then fill with 100 percent portland cement-based patching compound, as recommended in writing by manufacturer of concrete moisture-control coating.

D. Remove all residual dust and debris by vacuum and dry sweeping.

E. If necessary, place dehumidifiers in locations and for time period as required to achieve ambient humidity conditions in conformance with concrete moisture-control coating manufacturer's and cementitious overlay manufacturer's written recommendations.

3.4 CONCRETE MOISTURE-CONTROL COATING APPLICATION

A. Mixing: Mix separate components of concrete moisture-control coating in accordance with manufacturer's written instructions immediately prior to application.

1. Do not dilute with solvent or water.

B. Apply concrete moisture-control coating in accordance with manufacturer's written instructions. Achieve full coverage of all concrete surfaces, cracks, and joints.

1. Apply coating by squeegee and roller application to concrete surfaces, and in conformance with manufacturer's written instructions.

2. Conform with manufacturer's requirements for coverage rates and number of applications as needed to meet specified performance requirements.

3.5 CEMENTITIOUS OVERLAY INSTALLATION

A. After application and curing of moisture-control coating in accordance with manufacturer's written instructions, install cementitious overlay. Install in accordance with manufacturer's written instructions, to minimum thickness of 1/8 inch and as otherwise required to provide a smooth and continuous substrate suitable to receive finish flooring materials without the use of special adhesives or patching compounds.

1. Install primer at manufacturer's recommended spreading rate to surface of concrete moisture-vapor control coating prior to installation of cementitious overlay, if recommended by manufacturers of concrete moisture-vapor control coating and cementitious overlay.

B. Cure cementitious overlay according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3.6 PROTECTION

A. Protect concrete moisture-control system from damage and surface moisture during time prior to installation of finish flooring materials.

B. Do not install floor coverings over cementitious overlay until after time period recommended in writing by manufacturer of cementitious overlay has elapsed.

END OF SECTION 09 05 65

SECTION 09 06 00

COLORS AND FINISHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Color, pattern, and finish selections for products and materials specified in other specification Sections of this Project Manual.

B. Related Sections: Refer to Color/Finish Schedule in Part 3 for other sections specifying materials and products for which color and finish is specified in this Section.

1.3 SUBMITTALS

A. Samples: Submit Samples in accordance with requirements of individual Specification Sections for review of kind, color, pattern, and texture for Architect's review of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance for construction associated with each set.
    a. Samples that may be incorporated into the Work are indicated in individual specification sections. Such Samples must be in undamaged condition at time of use.
4. Samples for Initial Selection: Where color/finish is indicated as "selected by Architect," submit manufacturer's color charts or samples showing the full range of colors, textures, and patterns available.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES

A. In addition to Color/Finish Schedule in Part 3 of this Section, refer to Drawings and individual Specification Sections for information indicating extent and location of each color and finish designation specified in this Section.

B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review. Refer to Division 1 requirements for product substitutions.

PART 3 - EXECUTION

3.1 COLOR/FINISH SCHEDULE

A. Refer to following Color/Finish Schedules, to be used in conjunction with referenced Specification Sections, for color/finish selections. Refer to referenced Specification Section for product/material descriptive and performance criteria.

1. Where color/finish is indicated "As selected by Architect," refer to Part 1 "Submittals" Article for requirements for Samples for initial selection.

Section 06 41 00 – Architectural Wood Cabinets		
Designation	Description	Color/Finish
PL-1	Plastic laminate	*Wilsonart; Alabaster D431-60 Matte*
PL-2	Plastic laminate	*Nevamar; Visable Vava VA 2001T*
PL-3	Plastic laminate	*Nevamar; LN6001 Frappe*
EB-1	PVC edge banding	*To match PL-1*
EB-2	PVC edge banding	*To match PL-2*
EB-3	PVC edge banding	*To match PL-3*
LPL	Low-pressure laminate (melamine)	White
SS-1	Acrylic solid-surfacing material	*Corian; Rice Paper*

Color Schedule

Designation	Locations
PL-1	Upper Cabinets at Breakroom
PL-2	Base Cabinets at Breakroom
PL-3	Cabinet at Library
EB-1	Edge banding at PL-1
EB-2	Edge banding at PL-2
EB-3	Edge banding at PL-3
LPL	Semi-exposed surfaces of cabinets as defined in Section 06 41 00
SS-1	Countertops and splashes at Breakroom

Section 07 92 00 – Joint Sealants	
Description	Color/Finish
Silicone joint sealants	Refer to Section 07 92 00
Urethane joint sealants	Refer to Section 07 92 00

Section 09 30 00 – Ceramic Tile		
Designation	Description	Color/Finish
CT-1	Wall Tile	*Fireclay Tile; 3” Triangle; Caribbean*

Color Schedule

Designation	Locations
CT-1	Breakroom

Section 09 65 00 – Resilient Flooring		
Designation	Description	Color/Finish
BS-1	Bioplastic Sheet Flooring	*Wineo; 1500 Fusion; Cool*

Color Schedule

Designation	Locations
BS-1	Conference Center and Breakroom

Section 09 65 13 – Resilient Base		
Designation	Description	Color/Finish
RB-1	Rubber Wall Base	*Burke; 204 Gray*

RB-2	Rubber Wall Base	*Burke; 523 BlackBrown*

Color Schedule

Designation	Locations
RB-1	Library and Librarian
RB-2	Conference Center, Breakroom, and associated storage spaces

Section 09 68 13 – Tile Carpeting		
Designation	Description	Color/Finish
C-1	Carpet tile	*Masland; T515 Diminishing Grid "51503 Grating" – 50%*
C-2	Carpet tile	*Masland; T516 Subtle Impact "51503 Grating" – 50%*

Color Schedule

Designation	Locations
C-1 & C-2	Library and Librarian

Section 09 83 19 – Decorative Acoustical Wall Panels		
Designation	Description	Color/Finish
AP-1	Acoustic Panel	*Plyboo; Futura Sound Bitterwood 1*
AP-3	Acoustic Panel	*Plyboo; Futura Sound Bitterwood 3*
AP-6	Acoustic Panel	*Plyboo; Futura Sound Bitterwood 6*

Color Schedule

Designation	Locations
AP-1	Conference Center
AP-3	Conference Center
AP-6	Conference Center

Section 09 91 00 – Painting		
Designation	Description	Color/Finish
IP-1	Interior paint color	*Dunn Edwards; White DEW380*
IP-2	Interior paint color	*Dunn Edwards; Silver Spoon DE6366*
IP-3	Interior paint color	*Dunn Edwards; Covered in Platinum DE6367*

Color Schedule

Designation	Locations
IP-1	Interior gypsum board walls, Breakroom ceiling, and Library soffit
IP-2	Ceiling structure in Conference Center and Library
IP-3	Interior hollow-metal doors and hollow-metal frames

Section 12 22 13 – Drapes and Tracks	
Description	Color/Finish
Conference Room curtains	*Fabric: DesignTex Kabuto 4120-804*

Section 12 24 13 – Roller Shades		
Designation	Description	Color/Finish
RS-1	Roller Shade	*MechoShade Soho 1600 Series (3% Open) 1618 Black Brown*

Color Schedule

Designation	Locations
RS-1	Conference Center

END OF SECTION 09 06 00

SECTION 09 22 16

COLD-FORMED NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Non-load-bearing metal framing members for interior partition walls, framed soffits, furring, and other miscellaneous non-structural applications.
2. Metal backing plates for support of wall-mounted items on non-structural metal framing.

B. Related Sections include:

1. Section 09 29 00 ”Gypsum Board” for gypsum board panels supported by cold-formed non-structural metal framing.

1.3 DEFINITIONS

A. Non-Load-Bearing: Framing assembly which does not support gravity load from building structure or live loads, or exterior wind load.

B. STC: Sound Transmission Class.

1.4 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318: Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM A 27: Standard Specification for Steel Castings, Carbon, for General Application.
2. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM B 633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
4. ASTM C 645: Standard Specification for Nonstructural Steel Framing Members.
5. ASTM C 754: Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
6. ASTM C 840: Standard Specification for Application and Finishing of Gypsum Board.
7. ASTM C 1513: Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
8. ASTM E 90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

9. ASTM E 119: Standard Test Methods for Fire Tests of Building Construction and Materials.
10. ASTM E 413: Classification for Rating Sound Insulation.
11. ASTM E 488: Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
12. ASTM E 1190: Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
13. ASTM F 593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
14. ASTM F 594: Standard Specification for Stainless Steel Nuts.
15. ASTM F 1941: Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric.

C. American Welding Society (AWS).

D. European Standards (EN):
1. EN 15804: Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products.

E. International Code Council Evaluation Service (ICC-ES):
1. ICC-ES AC01: Acceptance Criteria for Expansion Anchors in Masonry Elements.
2. ICC-ES AC58: Acceptance Criteria for Adhesive Anchors in Masonry Elements.
3. ICC-ES AC70: Acceptance Criteria for Fasteners Power-Driven Into Concrete, Steel, and Masonry Elements.
4. ICC-ES AC308: Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

F. International Organization for Standardization (ISO):
1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).
2. ISO 14025: Environmental Labels and Declarations – Type III Environmental Declarations – Principals and Procedures.
3. ISO 14040: Environmental Management – Life Cycle Assessment – Principals and Framework.
4. ISO 14044: Environmental Management – Life Cycle Assessment – Requirements and Guidelines.
5. ISO 21930: Sustainability in Building Construction – Environmental Declaration of Building Products.

G. Steel Framing Industry Association (SFIA):
1. SFIA Technical Guide for Cold-Formed Steel Framing Products.

H. Steel Stud Manufacturers Association (SSMA).

1.5 COORDINATION

A. Coordinate locations of metal backing and reinforcements to ensure that surface mounted items specified in other Sections can be supported and installed as indicated. Surface mounted items include, but are not limited to, the following:
   1. Light fixtures.
   2. Fire alarm devices.
   3. Door hardware.
   4. Cabinets.
   5. Shelving.
   6. Wall panels or other surfacing systems.
   7. Audio-visual equipment.
   8. Curtain tracks.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of metal framing product and accessory indicated.

1.7 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.8 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate cold-formed non-structural metal framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 COLD-FORMED NON-STRUCTURAL METAL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed non-structural metal framing products that may be incorporated into the Work include, but are not limited to the following:
    a. California Expanded Metal Products Company (CEMCO).
    b. ClarkDietrich Building Systems.
    c. Consolidated Fabricators Corp.; Building Products Division.
    d. MarinoWare; a Division of Ware Industries.
    e. SCAFCO Corporation.
    f. Steeler, Inc.
    g. United Metal Products, Inc.
2. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
3. Grade: 33 ksi minimum yield strength, unless noted otherwise.
4. Protective Coating: ASTM A 653, G40 (Z120), hot-dip galvanized zinc coating, unless otherwise indicated.

B. Section Properties: For each indicated metal framing product, the following section properties are to be as specified in “Section Properties” portion of SFIA “Technical Guide for Cold-Formed Steel Framing Products:”

1. Section modulus.
2. Moment of inertia.
3. Allowable moment.

2.3 METAL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Tracks: ASTM C 645; manufacturer’s standard C-shaped sections; with stiffened flanges; punched, unless indicated as unpunched.

1. Minimum Base-Metal Thickness: 0.030 inch (20 gage), unless indicated otherwise.
2. Stud Flange Width: 1-1/4 inches, unless indicated otherwise.
3. Track Flange Width: 1-1/4 inches.
4. Provide products conforming with SFIA Product Designator codes as defined in of SFIA “Technical Guide for Cold-Formed Steel Framing Products,” as indicated below for each stud depth.
    a. 3-5/8-Inch Studs: 362S125-30.
    b. 4-Inch Studs: 400S125-30.
    c. 6-Inch Studs: 600S125-30.
    d. 8-Inch Studs: 800S125-30.

B. Slip-Type Head Joints: Manufacturer’s standard slotted deflection track system, capable of resisting lateral loads while accommodating upward and downward displacement of primary structure through positive attachment to stud; provide width to accommodate depth of stud being fastened; tested in accordance with ICC-ES AC261.

1. Material: Steel sheet, ASTM A 653, metallic-coated, as follows:
    a. Minimum Base-Metal Thickness: Not less than indicated for studs, but 0.030 inch (20 gage) minimum.
    b. Grade: 50 ksi minimum yield strength.
    c. Coating: G60 (Z180).
2. Provide manufacturer's standard bushings for use with screws in attaching track to studs, which ensure free movement in the vertical direction between track and stud.
3. Refer to Section 07 84 50 "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with cold-formed non-structural metal framing at fire-rated walls, to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance rating indicated.

C. Floor Tie Clips: Manufacturer's standard base clips and reinforcing plates for stud wall framing, capable of resisting vertical, horizontal, and torsional loads; provide size as recommended by manufacturer for depth of stud being fastened.
1. Tie Clip Material: Steel sheet; ASTM A 653, metallic-coated, as follows:
    a. Minimum Base-Metal Thickness: 0.118 inch (10 gage) minimum.
    b. Grade: 50 ksi minimum yield strength.
    c. Coating: G90 (Z275).
2. Provide manufacturer's standard reinforcing plate for use over horizontal leg of floor tie clips.
    a. Material: Carbon steel, ASTM A 27, Class C.
    b. Coating: ASTM B 633, Type 2.
3. Product: Subject to compliance with requirements, provide the following:
    a. ClarkDietrich Building Systems; MC Series.
    b. Steel Network, Inc., The; StiffClip CL Series.
        i) 3-5/8-Inch Stud Walls: #CL362-118(H).
        ii) 6-inch Stud Walls: #CL600-118(H).
        iii) 8-inch Stud Walls: #CL800-118(H).

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.054 inch (16 gage), unless indicated otherwise.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.030 inch (20 gage), unless indicated otherwise.
2. Depth: 7/8 inch, unless indicated otherwise.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4-inches, wall attachment flange of 7/8 inch, minimum base-metal thickness of 0.030-inch (20 gage), and depth required to fit insulation thickness indicated.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet of same grade and coating weight used for framing members.

1. Minimum Base-Metal Thickness: As indicated on Drawings.
    a. If not indicated, provide 0.0451-inch (18 gage) thickness.
2. Provide accessories of configuration indicated, to include the following:
    a. Supplementary framing.
    b. Bracing, bridging, and solid blocking.
    c. Zee-shaped furring.
    d. Web stiffeners.
    e. Anchor clips.
    f. End clips.
    g. Foundation clips.
    h. Gusset plates.
    i. Stud kickers, knee braces, and girts.
    j. Joist hangers and end closures.
    k. Hole reinforcing plates.
    l. Backer plates.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

B. Fasteners for Cold-Formed Metal Framing: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
    1. Head Type: Low-profile head beneath sheathing.

C. Post-Installed Anchors: Fastener systems with working capacity calculated according to ICC-ES Acceptance Criteria indicated, and ACI 318 greater than or equal to design load, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency, and according to evaluation report acceptable to authorities having jurisdiction, based on applicable substrate type.
    1. At Concrete: One of the following:
        a. Torque-Controlled Expansion Anchors: Working capacity calculated according to ICC-ES AC01.
            i) Product: Subject to compliance with requirements, provide one of the following:
                a) Hilti, Inc.; Kwik-Bolt TZ (KB-TZ), sizes as indicated on Drawings.

                    -Product Report: ICC-ES Evaluation Report #ESR-3785.
                b) Simpson Strong-Tie Company; Strong-Bolt 2, sizes as indicated on Drawings.

                    -Product Report: ICC-ES Evaluation Report #ESR-3037.
                c) Equal product in accordance with Division 1 requirements for product substitutions.
            ii) Expansion Anchor Material: As indicated in referenced Product Report, and as follows:

a) Exterior: Stainless-steel, Alloy Group 1 (Type 304), ASTM F 593 and ASTM F 594.

b) Interior: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn5, unless otherwise indicated.

b. Adhesive Anchors: Working capacity calculated according to ICC-ES AC308.

i) Product: Subject to compliance with requirements, provide one of the following:

a) Hilti, Inc.; HY 200, with HAS anchor rod, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3187.

b) Simpson Strong-Tie Company; ET-HP, with anchor rod sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3372.

c) Equal product in accordance with Division 1 requirements for product substitutions.

ii) Anchor Rod and Nut Material: As indicated in referenced Product Report, and as follows:

a) Exterior: Stainless-steel, Alloy Group 1 (Type 304), ASTM F 593 and ASTM F 594.

b) Interior: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn5, unless otherwise indicated.

2. At Masonry: Adhesive anchors. Working capacity calculated according to ICC-ES AC58.

a. Product: Subject to compliance with requirements, provide one of the following:

i) Hilti, Inc.; HY 70, with HAS anchor rod, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-2682.

ii) Simpson Strong-Tie Company; SET, with anchor rod sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-1772.

iii) Equal product in accordance with Division 1 requirements for product substitutions.

b. Anchor Rod and Nut Material: As indicated in referenced Product Report, and as follows:

i) Exterior: Stainless-steel, Alloy Group 1 (Type 304), ASTM F 593 and ASTM F 594.

ii) Interior: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn5, unless otherwise indicated.

D. Power-Actuated Fasteners: Direct-fastening system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

1. Provide 0.08-inch minimum by 1.425 inches diameter steel washers under the heads of all power-actuated fasteners.

2. Product: Subject to compliance with requirements, provide one of the following:

a. Hilti, Inc.; X-U, sizes as indicated on Drawings.
   i) Product Report: ICC-ES Evaluation Report #ESR-2269.
b. Simpson Strong-Tie Company; PDPA.
   i) Product Report: ICC-ES Evaluation Report #ESR-2138.
c. Equal product in accordance with Division 1 requirements for product substitutions.

E. Welding Electrodes: Comply with AWS standards.

F. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination with Sprayed-Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches on center.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of cold-formed non-structural metal framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

B. Verify locations of all surface-mounted items requiring metal backing or support framing.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and backing to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building expansion joints with cold-formed non-structural metal framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry or concrete walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

C. Space studs at 16 inches on center unless noted otherwise.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies while providing lateral support.
2. Low Walls: At low-height freestanding walls, install floor tie clips in accordance with manufacturer's written instructions, except where indicated otherwise.
3. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    a. Install two studs at each jamb, unless otherwise indicated.
    b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
4. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
5. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures to make partitions continuous from floor to underside of solid structure.
    a. Refer to Section 07 84 50 "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with slip-type head joints, to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rating indicated.
6. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
7. Curved Partitions:
    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than two studs at ends of arcs, place studs at 6 inches on center.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or power-actuated fasteners spaced 24 inches on center.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING JOISTS

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: 16 inches on center, unless indicated otherwise.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

E. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.

F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

END OF SECTION 09 22 16

SECTION 09 28 16

GLASS-MAT-FACED GYPSUM BACKING BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Glass-mat-faced gypsum backing board.

B. Related Sections include:
   1. Section 09 29 00 “Gypsum Board” for moisture- and mold-resistant gypsum board.
   2. Section 09 30 00 “Ceramic Tile” for ceramic tile and setting materials installed over glass-mat-faced gypsum backing board.

1.3 REFERENCES

A. ASTM International:
   1. ASTM C 840: Standard Specification for Application and Finishing of Gypsum Board.
   2. ASTM C 1178: Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
   3. ASTM D 3273: Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
   4. ASTM D 3274: Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
   5. ASTM E 119: Standard Test Methods for Fire Tests of Building Construction and Materials.

B. Gypsum Association (GA):
   1. GA-216: Application and Finishing of Gypsum Panel Products.

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep dry and protected against weather, condensation, direct sunlight, surface contamination, corrosion, construction traffic, and other

potential causes of damage. Stack glass-mat-faced gypsum backing board panels flat and supported on risers on a flat platform to prevent sagging.

C. Handle glass-mat-faced gypsum backing boards to prevent damage to edges, ends, and surfaces.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements and glass-mat-faced gypsum backing board manufacturer's written instructions for allowable ambient temperature ranges. Do not install backing board until installation areas are enclosed and weatherproof.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GLASS-MAT-FACED GYPSUM BACKING BOARD

A. Glass-Mat-Faced Gypsum Backer Board: Mold-resistant gypsum core with glass-fiber mat facing and acrylic or cementitious coating; ASTM C 1178; in maximum lengths available to minimize end-to-end butt joints.

1. Product: Subject to compliance with requirements, provide one of the following:
    a. Georgia-Pacific Gypsum; DensShield.
    b. National Gypsum Company; Gold Bond eXP Tile Backer.
    c. USG Corporation; DUROCK Brand Glass-Mat Tile Backerboard.
    d. Equal product in accordance with Division 1 requirements for product substitutions.
2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
4. VOC Emissions: Complying with the testing and product requirements of the California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010," using the applicable exposure scenario.

2.3 ACCESSORIES

A. Fasteners: Corrosion-resistant fasteners of type and size as recommended by glass-mat-faced backing board manufacturer for intended substrate and framing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine glass-mat-faced gypsum backing board panels before installation. Reject panels that are wet or damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install glass-mat-faced gypsum backing board, and treat joints according to ASTM C 840, applicable requirements of GA-216, and in accordance with manufacturer's written instructions for type of application indicated.

B. Install panels with acrylic-coated face at exposed side, for installation of ceramic tile.

C. Locate panel edges and end joints over continuous supports.

D. Butt panels together for a light contact at edges and ends with not more than 1/16-inch of open space between panels. Do not force into place.

E. Fit panels around ducts, pipes, and conduits.

F. Space fasteners in glass-mat-faced gypsum backing board panels according to referenced installation standard and manufacturer's written instructions.

G. Refer to Section 09 30 00 "Ceramic Tile" for treatment of joints between glass-mat gypsum backing board panels

END OF SECTION 09 28 16

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Gypsum board.
   2. Texture finishes.
   3. Cutting and patching of existing gypsum board.

B. Related Sections include:
   1. Section 09 22 16 ”Cold-Formed Non-Structural Metal Framing” for non-structural cold-formed metal framing and accessories, including interior partition walls, furring, framed soffits, and ceiling joists that support gypsum board.
   2. Section 09 22 28 “Ceiling Grid Suspension System” for manufactured suspended-grid ceiling suspension system for gypsum board.
   3. Section 09 91 00 “Painting” for primers and finish coats applied to gypsum board surfaces.

1.3 REFERENCES

A. ASTM International:
   1. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM B 221: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   3. ASTM C 475: Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
   4. ASTM C 645: Standard Specification for Nonstructural Steel Framing Members.
   5. ASTM C 834: Standard Specification for Latex Sealants.
   6. ASTM C 840: Standard Specification for Application and Finishing of Gypsum Board.
   7. ASTM C 919: Standard Practice for Use of Sealants in Acoustical Applications.
   8. ASTM C 954: Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112 inch in Thickness.
   9. ASTM C 1002: Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

10. ASTM C 1047: Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
11. ASTM C 1396: Standard Specification for Gypsum Board.
12. ASTM C 1629: Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
13. ASTM C 1658: Standard Specification for Glass Mat Gypsum Panels.
14. ASTM D 3273: Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
15. ASTM D 3274: Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
16. ASTM E 90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
17. ASTM E 119: Standard Test Methods for Fire Tests of Building Construction and Materials.
18. ASTM E 413: Classification for Rating Sound Insulation.

B. California Department of Public Health (CDPH):
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

C. California Green Building Standards Code (CALGreen) – California Code of Regulations, Title 24, Part 11.

D. Gypsum Association (GA):
1. GA-214: Recommended Levels of Gypsum Board Finish.

E. South Coast Air Quality Management District (SCAQMD):
1. Rule 1168 – Adhesive and Sealant Applications.

F. UL Environment:
1. GREENGUARD Gold certification program.

1.4 DEFINITIONS

A. STC: Sound Transmission Class.

B. VOC: Volatile Organic Compound.

1.5 ACTION SUBMITTALS

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

B. CALGreen Submittals:
1. Manufacturer’s product data for sealants and laminating adhesives, indicating compliance with product requirements specified in “CALGreen Requirements” Article.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall assemblies incorporating sound isolation clips.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 50 square feet in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Build mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
   2. Apply or install final decoration indicated, including painting and wall-coverings, on exposed surfaces for review of mockups.
   3. Simulate finished lighting conditions for review of mockups.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed and integrated into adjacent surfaces at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, surface contamination, corrosion, construction traffic, and other potential causes of damage. Stack gypsum panels flat and supported on risers on a flat platform to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads or trim.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer’s written insructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Provide acoustical sealant and primer, and gypsum board laminating adhesive which complies with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule 1168, except as noted otherwise below. Such products shall also comply with Rule 1168 prohibition of the use of certain toxic compounds (chloroform, ethylene, dichloride, methylene chloride, perchloroethylene, and trichloroethyelen).

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.3 GYPSUM BOARD

A. Gypsum Panel Sizes: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Gypsum Board: Type X, ASTM C 1396.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Georgia-Pacific Gypsum LLC; ToughRock Fireguard X.
      b. National Gypsum Company; Gold Bond Fire-Shield Gypsum Board.
      c. USG Corporation; SHEETROCK Brand Firecode X Gypsum Panel.
      d. Equal product in accordance with Division 1 requirements for product substitutions.
   2. Thickness: 5/8 inch.
   3. Long Edges: Tapered.
   4. VOC Emissions: Complying with the testing and product requirements of the California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010," using the applicable exposure scenario.
      a. Certification: UL Environment; GREENGUARD Gold.

C. Moisture- and Mold-Resistant Gypsum Board: Type X, ASTM C 1396.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Georgia-Pacific Gypsum LLC; ToughRock Fireguard X Mold-Guard.
      b. National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board.
      c. USG Corporation; SHEETROCK Brand Mold Tough Firecode X Panel.
      d. Equal product in accordance with Division 1 requirements for product substitutions.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
5. VOC Emissions: Complying with the testing and product requirements of the California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010," using the applicable exposure scenario.
    a. Certification: UL Environment; GREENGUARD Gold.

2.4 SOUND ISOLATION CLIPS

A. General: Manufacturer's mounting clip for securing hat channel furring away from face of framing member to provide acoustical isolation between gypsum board and framing member. Clip designed to securely hold standard 7/8-inch deep metal hat channel within resilient rubber housing.
1. Product: Subject to compliance with requirements, provide the following:
    a. Kinetics Noise Control, Inc.; IsoMax.
2. Provide sound isolation clips that, when incorporated into the following wall assemblies, result in the indicated ratings, as determined by ASTM E 413 when tested according to ASTM E 90:
    a. One layer of 5/8 inch gypsum board at each side of 2x4 studs at 16 inches on center with fiberglass batt insulation: STC 57.
    b. Two layers of 5/8 inch gypsum board at each side of 2x4 studs at 16 inches on center with fiberglass batt insulation: STC 63.
3. Design Load Capacity: Pullout force of hat channel from clip shall meet the following minimum values, when tested in a horizontal orientation (e.g. ceiling) with load applied downward:
    a. 25 Gage Hat Channel: 36 lbs.
    b. 22 Gage Hat Channel: 48 lbs.

2.5 TRIM ACCESSORIES

A. Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
    a. Cornerbead: Type with face flange to receive joint compound.
    b. LC-bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Provide materials complying with ASTM C 475 and the recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

B. Joint Tape:

1. Paper-Faced Gypsum Board: Paper.
2. Glass-Mat-Faced Gypsum Board: 10-by-10 threads per inch glass-fiber mesh of type recommended by glass-mat-faced gypsum board manufacturer.

C. Joint Compound for Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 inch (22 gage) to 0.112 inch (12 gage) thick.

C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0346 inch (20 gage), unless indicated otherwise.
2. Protective Coating: ASTM A 653, G60 (Z180).
3. Depth: 7/8 inch, unless indicated otherwise.

D. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical, with face attached to single flange by a slotted leg (web).

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
b. USG Corporation; SHEETROCK Brand Acoustical Sealant.
c. Equal product in accordance with Division 1 requirements for product substitutions.
2. VOC Content: Complies with requirements specified in "CALGreen Requirements" Article.

F. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

G. Sound Attenuation Blankets: As specified in Section 07 21 00 “Building Insulation.”

2.8 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish.
1. Texture: Fine.
2. Products: Subject to compliance with requirements, provide one of the following:
a. National Gypsum Company; ProForm Perfect Spray.
b. USG Corporation; SHEETROCK Brand Ceiling Spray Texture, QT Poly.
c. Equal product in accordance with Division 1 requirements for product substitutions.

C. Non-Aggregate Finish: Premixed, unaggregated texture finish for spray application.
1. Texture: Orange peel.
2. Products: Subject to compliance with requirements, provide one of the following:
a. National Gypsum Company; ProForm Wall & Ceiling Spray.
b. USG Corporation; SHEETROCK Brand Wall and Ceiling Spray Texture.
c. Equal product in accordance with Division 1 requirements for product substitutions..

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine gypsum board panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CUTTING AND PATCHING

A. Cut, patch, replace, and repair existing gypsum board surfaces as necessary to accommodate other work, including installation of concealed conduits and backing in existing wall cavities, and to remove dents and other imperfections, and restore surface to specified finish levels.

B. When cutting out sections of existing gypsum board areas, cut gypsum board along supporting framing members.

C. When patching and infilling existing gypsum board areas, produce invisible joint between existing and new surfaces. Match existing gypsum board finish.

3.3 APPLYING AND FINISHING GYPSUM BOARD PANELS

A. Comply with ASTM C 840.

B. Where indicated, install sound attenuation blankets and thermal batt insulation in accordance with requirements of Section 07 21 00 “Building Insulation,” before installing gypsum board panels, unless blankets are readily installed after panels have been installed on one side.

1. Place insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through ceilings.

C. Install Type X gypsum board panels at all locations. ***[except as follows:]***

1. Moisture- and Mold-Resistant Gypsum Board: As indicated on Drawings.

D. Install ceiling gypsum board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

E. Install gypsum board panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16-inch of open space between panels. Do not force into place.

F. Locate panel edges and end joints over continuous supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

1. Attach gypsum board panel edges to framing provided at perimeter of openings and cutouts.

G. Form control and expansion joints with space between edges of adjoining gypsum board panels.

H. Cover both faces of stud partition framing with gypsum board panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 square feet in area.

I. Attachment to Cold-Formed Metal Framing: Attach gypsum board panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges, first.

J. Fit gypsum board panels around ducts, pipes, and conduits.

K. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum board panels to fit profile formed structural members; allow 1/4 to 3/8-inch wide joints to install sealant.

L. Isolate perimeter of gypsum board panels applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

1. Refer to Section 07 84 50 “Fire-Resistive Joint Systems” for head-of-wall joint systems at fire-rated partitions.

M. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer’s written instructions for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above suspended ceilings.

1. Install resilient furring channels in accordance with manufacturer’s written instructions.
2. Install sound isolation clips in accordance with manufacturer’s written instructions.

N. Space fasteners in gypsum board panels according to referenced gypsum board application and finishing standard and manufacturer’s written instructions.

O. Single-Layer Application:

1. On ceilings, apply gypsum board panels before wall/partition gypsum board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum board panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of gypsum board panels.
3. On Z-furring members, apply gypsum board panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum board panels to supports with steel drill screws.

P. Multi-Layer Application:

1. On ceilings, apply gypsum board panels indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board panels indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistive-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one framing member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

Q. Laminating to Substrate: Where gypsum board panels are indicated as directly adhered to substrate (other than studs, joists, furring members, or base layer of gypsum board), comply

with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated, according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Install trim as follows:

1. Cornerbead: Use at outside corners.
2. LC-Bead (J-Bead): Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to GA-214 "Recommended Levels of Gypsum Board Finish."

1. Gypsum board to receive paint finish, and as indicated otherwise: Level 4 ***[Level 5]***.
    a. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges***[, followed by skim coat over entire surface]***.
2. Gypsum board to receive flat paint finish or vinyl wall covering: Level 4.
    a. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
3. Gypsum board occurring behind tackable panels, acoustical panels, and impact-resistant wall covering: Level 3.
    a. Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges.
4. Gypsum board in concealed locations: Level 1 (except as required otherwise by listed designs for fire and sound construction).
    a. Embed tape at joints.

3.6 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum board and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.7 PROTECTION

A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet or moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 00

CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Ceramic tile.
      a. Wall tile.
   2. Mortar beds for ceramic tile.
   3. Waterproof/crack isolation membrane for tile installations.
   4. Sealants for ceramic tile expansion joints.
   5. Grout for ceramic tile.

B. Related Sections include:
   1. Section 09 28 16 “Glass-Mat-Faced Gypsum Backing Board” for glass-mat-faced gypsum backing board substrate for ceramic tile thinset installations.

1.3 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI A108 Series: Specifications for Installation of Ceramic Tile.
      a. A108.01: General Requirements: Subsurfaces and Preparations by Other Trades.
      b. A108.02: General Requirements: Materials, Environmental, and Workmanship.
      c. A108.6: Ceramic Tile Installed With Chemical Resistant, Water Cleanable Tile-Setting and –Grouting Epoxy.
      d. A108.10: Installation of Grout in Tilework.
      e. A108.11: Interior Installation of Cementitious Backer Units.
      f. A108.13: Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
      g. A108.17: Installation of Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone.
   2. ANSI A118.3: Specifications for Chemical-Resistant Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
   3. ANSI A118.4: Specifications for Modified Dry-Set Mortar.
   4. ANSI A118.6: Specifications for Standard Cement Grouts for Tile Installation.

5. ANSI A118.10: Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installations.
6. ANSI A118.12: Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation.
7. ANSI A137.1: Specifications for Ceramic Tile.

B. ASTM International:
1. ASTM A 666: Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
2. ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
3. ASTM C 373: Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products.
4. ASTM C 648: Standard Test Method for Breaking Strength of Ceramic Tile.
5. ASTM C 650: Standard Test Method for Resistance of Ceramic Tile to Chemical Substances.
6. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
7. ASTM D 4397: Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

C. California Department of Public Health (CDPH):
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

D. California Green Building Standards Code (CALGreen) – California Code of Regulations, Title 24, Part 11.

E. International Organization for Standardization (ISO):
1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).

F. South Coast Air Quality Management District (SCAQMD):
1. Rule 1168 – Adhesive and Sealant Applications.

G. Tile Council of North America (TCNA).
1. TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.

H. UL Environment:
1. GREENGUARD Gold certification program.

1.4 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Module Size: Actual tile size plus joint width indicated.

C. Face Size: Actual tile size, excluding spacer lugs.

1.5 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site to review pertinent issues related to ceramic tiling.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

i)

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.

a. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

2. Assembled samples mounted on a rigid panel, with grouted joints and one sealant-filled expansion joint, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.

3. Full-size units of each type of trim and accessory.

4. Metal edge strips in 6-inch lengths.

D. CALGreen Submittals:

1. Manufacturer’s product data for sealants and sealant primers, and tile-setting adhesives and grouts indicating compliance with product requirements specified in “CALGreen Requirements” Article.

1.7 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product, signed by product manufacturer.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to ***[3]*** percent of amount installed for each type, composition, color, pattern, and size indicated.

1.9 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of each type of wall tile installation.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store liquid materials in unopened containers and protected from freezing.

D. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type from single source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
   2. Obtain combination waterproofing/crack isolation membrane from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Joint sealants.
   2. Metal edge strips.

2.2 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Provide sealant and sealant primers, and tile-setting adhesives and grout which comply with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule 1168, except as noted otherwise below. Such products shall also comply with Rule 1168 prohibition of the use of certain toxic compounds (chloroform, ethylene, dichloride, methylene chloride, perchloroethylene, and trichloroethyelen).

2.3 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 Articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in swimming pools, on exteriors, or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.4 TILE PRODUCTS

A. General: Tested requirements indicated for each tile type are in accordance with the following standards:

1. Dynamic Coefficient of Friction: As tested per ANSI A137.1 AcuTest, using BOT-3000E digital tribometer.
2. Water Absorption: ASTM C 373.
3. Breaking Strength: ASTM C 648.
4. Scratch Hardness: MOHS Scale.
5. Chemical Resistance: ASTM C 650.

B. Glazed Interior Wall Tile (designated as CT-1on Drawings):

1. Product: Subject to compliance with requirements, provide one of the following:
   a. Fireclay Tile
      i) Pattern: On the Point
   b. Equal product in accordance with Division 1 requirements for product substitutions.

2. Module Size: 3” Triangle
3. Thickness: approx. 5/16”
4. Weight: approx. 3.7 lbs. psf
5. Recycled content: at least 50%
6. Face: Plain, with modified square edges.
7. Finish: Gloss with Engobe, lead-free.
8. Breaking Strength: 381 lbs.
9. Scratch Hardness: 4.0 -6.5 MOH.
10. Acid Resistant: No (acceptable for use without sealant as kitchen backsplash)
11. Color: As specified in Section 09 06 00 “Colors and Finishes.”

2.5 COMBINATION WATERPROOF/CRACK ISOLATION MEMBRANE

A. General: Manufacturer’s standard product that complies with ANSI A118.10 and ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. Product: Subject to compliance with requirements, provide the following:
a. Ardex Americas; 8+9.
b. Laticrete International, Inc.; Hydroban.
c. Mapei Corporation: Mapelastic Aqua Defense.
d. Equal product in accordance with Division 1 requirements for product substitutions.

C. Latex Portland Cement Mortar (Thinset): ANSI A118.4, consisting of the following:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Ardex Americas; X 5.
b. Laticrete International, Inc.; 254 Platinum.
c. Mapei Corporation; Kerabond Dryset Mortar with Keralastic additive.
d. Equal product in accordance with Division 1 requirements for product substitutions.
2. Prepackaged dry-mortar mix, polymer-modified.
a. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.
3. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

2.6 GROUT MATERIALS

A. Standard Unsanded Cement Grout: ANSI A118.6.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Ardex Americas; FG-C.
b. Laticrete International, Inc.; 1600 Unsanded Grout.

c. Mapei Corporation; Keracolor U.

2. Color: As specified in Section 09 06 00 ”Colors and Finishes.”

3. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

2.7 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 07 92 00 “Joint Sealants.”

1. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT or T.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Degussa Building Systems; Sonneborn Sonolastic NP 2.

b. Pecora Corporation; DynaTrol II.

c. Sika Corporation; Sikaflex-2c NS EZ Mix.

d. Equal product in accordance with Division 1 requirements for product substitutions.

D. Mildew-Resistant, Single-Component, Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 786 Mildew Resistant.

b. GE Advanced Materials – Silicones; Sanitary SCS1700.

c. Equal product in accordance with Division 1 requirements for product substitutions.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Reinforcing Mesh: Alkali-resistant woven glass-fiber mesh as recommended by manufacturer of tile backing panels.

C. Metal Edge Strips: L-shape; perforated anchoring leg with ability to form radiused curves along length of edge strip, height to match tile and setting-bed thickness, designed specifically as a termination edge at flooring applications; stainless-steel, ASTM A 666 Type 304 exposed-edge material.

1. Products: Subject to compliance with requirements, provide the following:
    a. Schluter Systems; Schiene.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard no-sheen product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, provide the following:
    a. Aquamix; Sealer's Choice Gold.
    b. Equal product in accordance with Division 1 requirements for product substitutions.
2. VOC Content: Complies with requirements specified in "CALGreen Requirements" Article.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare floor substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1B and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE BACKING PANEL INSTALLATION

A. Install coated glass-mat gypsum backer units as specified in Section 09 28 16 “Glass-Mat-Faced Gypsum Backing Board” and treat joints according to ANSI A108.11 and manufacturer’s written instructions for type of application indicated.

1. Install reinforcing mesh at joints by embedding in tile setting material in accordance with manufacturer’s written instructions.

3.4 COMBINATION WATERPROOF/CRACK ISOLATION MEMBRANE INSTALLATION

A. Install combination waterproof/crack isolation membrane to comply with ANSI A108.13 and ANSI A108.17 and manufacturer’s written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Do not install tile or setting materials over waterproof/crack isolation membrane until membrane has been installed and cured in accordance with manufacturer’s written instructions and tested to determine that it is watertight.

1. At shower floors, verify that waterproofing is continuous at wall/floor transition, and water runs to drains.

3.5 CERAMIC TILE INSTALLATION

A. Comply with TCNA’s “Handbook for Ceramic, Glass, and Stone Tile Installation” for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series “Specifications for Installation of Ceramic Tile” that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that face of tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles of floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Glazed Interior Wall Tile: 3/16"
    a. Smaller joints are possible. If deviating from the recommended grout joint size, please have a suitable mock up made that will mimic conditions on the job site.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Grout tile to comply with TCNA installation methods specified in tile installation schedules.

1. For cement grouts, comply with ANSI A108.10.
2. For grouting epoxy, comply with ANSI A108.6.

J. Metal Edge Strips: Install at locations indicated.

K. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Wall Installations:

1. Tile Installation W245: Thinset mortar on coated glass-mat gypsum backer units (include combination waterproof/crack isolation membrane between coated glass-mat gypsum backer units and thinset bond coat, where indicated on Drawings); TCNA W245.
    a. Locations: Breakroom Backsplash
    b. Tile Type: Glazed interior wall tile.
    c. Thinset Mortar: Latex-portland cement mortar.
    d. Grout: Unsanded Grout

END OF SECTION 09 30 00

SECTION 09 51 13

SUSPENDED LAY-IN PANEL CEILINGS

PART 1 - GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes suspended ceiling system consisting of exposed suspension system and lay-in panels.

B. Related Sections include:

1. Section 07 92 00 “Joint Sealants” for acoustical joint sealant installed behind perimeter wall moldings for suspended lay-in panel ceilings.
2. Division 21 Section for fire sprinkler system in suspended lay-in panel ceiling system.
3. Division 23 Section for air terminals in suspended lay-in panel ceiling system.
4. Division 26 Section for light fixtures in suspended lay-in panel ceiling system.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318: Building Code Requirements for Structural Concrete.

B. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):

1. ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. American Society of Mechanical Engineers (ASME):

1. ASME B18.6.1: Wood Screws.
2. ASME B18.6.4: Thread Forming and Thread Cutting Screws.

D. ASTM International:

1. ASTM A 580: Standard Specification for Stainless Steel Wire.
2. ASTM A 641: Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
3. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM B 633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

5. ASTM C 635: Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
6. ASTM C 636: Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
7. ASTM C 645: Standard Specification for Nonstructural Steel Framing Members.
8. ASTM D 3273: Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
9. ASTM D 3274: Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
10. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
11. ASTM E 119: Standard Test Methods for Fire Tests of Building Construction and Materials.
12. ASTM E 488: Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
13. ASTM E 580: Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
14. ASTM E 795: Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
15. ASTM E 1190: Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
16. ASTM E 1264: Standard Classification for Acoustical Ceiling Products.
17. ASTM F 593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. ASTM F 594: Standard Specification for Stainless Steel Nuts.
19. ASTM F 1941: Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric.
20. ASTM G 21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

E. California Building Code (CBC) – California Code of Regulations, Title 24, Part 2.

F. California Department of Public Health (CDPH):
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

G. Ceilings & Interior Systems Construction Association (CISCA):
1. Ceiling Systems Handbook.

H. Division of the State Architect (DSA):
1. Interpretation of Regulations Document IR 25-2.13: Metal Suspension Systems for Lay-In Panel Ceilings: 2013 CBC (Last Revision: 11/9/17).

I. International Code Council Evaluation Service, Inc. (ICC-ES).

1. ICC-ES AC01: Acceptance Criteria for Expansion Anchors in Masonry Elements.
2. ICC-ES AC70: Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel, and Masonry Elements.
3. ICC-ES AC308: Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

J. International Organization for Standardization (ISO):

1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).

K. National Association of Architectural Metal Manufacturers (NAAMM):

1. Metal Finishes Manual for Architectural and Metal Products.

L. National Voluntary Laboratory Accreditation Program (NVLAP).

M. Underwriters Laboratories (UL).

1. Fire Resistance Directory.

N. United States Department of Agriculture (USDA).

1.4 DEFINITIONS

A. CAC: Ceiling Attenuation Class.

B. DSA: Division of the State Architect.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.5 COORDINATION

A. Coordinate layout and installation of lay-in ceiling panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.6 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site to review pertinent issues related to installation of suspended lay-in panel ceilings.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For components with factory-applied color finishes, submit manufacturer's full range of available colors for selection by Architect.)

1. Minimum Number of Colors for Selection:

a. Exposed Suspended Ceiling Runners: 10.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Lay-In Panel: Set of 6-inch square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch long Samples of each type, finish, and color.

1.8 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components, including suspension system members and seismic compression strut and bracing assemblies.
2. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
3. Method of attaching hangers to building structure.
4. Structural members to which suspension systems will be attached.
    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
5. Items penetrating finished ceiling and ceiling-mounted items including the following:
    a. Light fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Audio-visual equipment mounting hardware.
6. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to lay-in panels.

B. Product Test Reports: For each suspended lay-in panel ceiling, for tests performed by a qualified testing agency.

C. Evaluation Reports:

1. For each suspended lay-in panel ceiling suspension system, from ICC-ES.
    a. Include valid ICC-ES Evaluation Report for seismic clip used to attach ends of ceiling grid runners to wall at free end while allowing 3/4-inch movement in either direction.
2. For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.9 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.10 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lay-In Ceiling Panels: Full-size panels equal to ***[2]*** percent of quantity installed.

2. Suspension System Components: Quantity of each exposed component equal to ***[2]*** percent of quantity installed.

1.11 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical ceiling area as directed by Architect.

2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver lay-in panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing lay-in panels, permit them to reach room temperature and stabilized moisture content.

C. Handle lay-in panels carefully to avoid chipping edges or damaging units in any way.

1.13 FIELD CONDITIONS

A. Environmental Limitations: Do not install suspended lay-in panel ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning suspended lay-in panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of lay-in ceiling panel and supporting suspension system through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Design Requirements: Provide ceiling suspension system that complies with requirements of the California Building Code (Title 24, Part 2), including ability to withstand effects of all design loads and earthquake motions calculated according to requirements of the California Building Code, using factors defined therein and applicable to local site conditions, without showing permanent deformation of ceiling system components including panels and suspension system, or permanent damage to to fasteners and anchors.

1. Comply with requirements of California Division of the State Architect Interpretation of Regulations IR 25-2.13, “Metal Suspension Systems for Lay-in Panel Ceilings: 2013 CBC.” (Last Revision: 11/9/17).

B. Fire-Test-Response: Provide suspended lay-in panel ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.

b. Smoke-Developed Index: 50 or less.

2. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Indicate design designations from UL’s “Fire Resistance Directory” or from the listings of another qualified testing agency

2.3 LAY-IN CEILING PANELS, GENERAL

A. Lay-In Panel Standard: Provide manufacturer’s standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, forms, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4-inches away from test surface according to ASTM E 795.

B. Antimicrobial Treatment: Where ceiling panels are indicated to receive antimicrobial treatment, provide manufacturer’s standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive bacteria and showing not mold, mildew or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 LAY-IN CEILING PANELS

A. Lay-in Acoustical Panel – Type LCP-1:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; #2820, Calla

b. Equal product in accordance with Division 1 requirements for product substitutions.

2. ASTM E 1264 Classifications:
   a. Type: Type IV, mineral base with painted finish.
   b. Form: Form 2, water felted.
   c. Pattern: E
   d. Fire Class: A
3. Dimensions: 24 inches by 24 inches by 1 inch thick.
4. Edges: Square.
5. Color: White.
6. NRC: 0.85 minimum.
7. CAC: 35 minimum.
8. LR: 0.85 minimum.
9. Mold/Mildew Protection: Manufacturer's antimicrobial treatment.
10. Recycled Content: Greater than 50% total recycled content
11. VOC Emissions: Complies with the testing and product requirements of the California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010," using the applicable exposure scenario.
12. Warranty: 30-year warranty against visible sagging, mold/mildew, and bacterial growth.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635 and ASTM E 580.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   1. Mechanical Fasteners: ASME B18.6.4, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   2. Wood Screws: ASME B18.6.1.
   3. Post-Installed Anchors for Concrete: Fastener systems with working capacity calculated according to ICC-ES Acceptance Criteria indicated, and ACI 318 greater than or equal to design load, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency, and according to evaluation report acceptable to authorities having jurisdiction, based on applicable substrate type.

a. Torque-Controlled Expansion Anchors: Working capacity calculated according to ICC-ES AC01.

i) Product: Subject to compliance with requirements, provide one of the following:

a) Hilti, Inc.; Kwik-Bolt TZ (KB-TZ), sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3785.

b) Simpson Strong-Tie Company; Strong-Bolt 2, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3037.

c) Equal product in accordance with Division 1 requirements for product substitutions.

ii) Expansion Anchor Material: As indicated in referenced Product Report, and as follows:

a) Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn5, unless otherwise indicated.

b. Adhesive Anchors: Working capacity calculated according to ICC-ES AC308.

i) Product: Subject to compliance with requirements, provide one of the following:

a) Hilti, Inc.; HY 200, with HAS anchor rod, sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3187.

b) Simpson Strong-Tie Company; ET-HP, with anchor rod sizes as indicated on Drawings.

-Product Report: ICC-ES Evaluation Report #ESR-3372.

c) Equal product in accordance with Division 1 requirements for product substitutions.

ii) Anchor Rod and Nut Material: As indicated in referenced Product Report, and as follows:

a) Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn5, unless otherwise indicated.

4. Power-Actuated Fasteners for Concrete: Direct-fastening system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

a. Provide 0.08-inch minimum by 1.425 inches diameter steel washers under the heads of all power-actuated fasteners.

b. Products: Subject to compliance with requirements, provide one of the following:

i) Hilti, Inc.; X-U, sizes as indicated on Drawings.

a) Product Report: ICC-ES Evaluation Report #ESR-2269.

ii) Simpson Strong-Tie Company; PDPA.

a) Product Report: ICC-ES Evaluation Report #ESR-2138

iii) Equal product in accordance with Division 1 requirements for product substitutions.

D. Wire Hangers, Braces, Safety Wires, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, “Direct Hung”) will be less than yield stress of wire, but provide not less than 0.106-inch diameter (12 gage) wire or as otherwise indicated on Drawings.

E. Anchor Clips: Angles with legs of width as indicated on Drawings, or if not indicated, 1-inch-wide at concrete decks and 3-inch-wide at steel decks (e.g. without concrete fill); provide hole for attaching hanger and bracing wires; unless otherwise indicated, formed of 0.1084-inch thick (12 gage) galvanized steel sheet complying with ASTM A 653, G90 (Z275) coating designation; with attachment devices as indicated on Drawings.

F. Compression Strut for Seismic Uplift: ASTM C 645; standard C-shaped steel stud section; with stiffened flanges; unpunched.

1. Stud Flange Width: 1-5/8 inch.

2. Stud Depth: 2-1/2 inches

3. Base-Metal Thickness: 0.0346 inch (20 gage - Structural)

4. Grade: 33 ksi minimum yield strength.

5. Protective Coating: ASTM A 653, G40 (Z120) hot-dip galvanized zinc coating.

G. Seismic Stabilizer Bars: Manufacturer’s standard perimeter stabilizers designed to accommodate seismic forces and maintain alignment of grid.

H. Clean-Room Gasket System: Where indicated, provide manufacturer’s standard system, including manufacturer’s standard gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean-room.

2.6 METAL SUSPENSION SYSTEM

A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653, not less than G30 (Z90) coating designation, with prefinished 15/16-inch wide metal caps on flanges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Prelude XL Exposed Tee System.

i) Edge Molding Clip at Free End of Runners and Tees: Armstrong BERC-2 clip.

ii) Seismic Joint Clips:

-Main Runners: Armstrong #SJMR15 with #ES4 sliding face cap.

-Cross Runners: Armstrong #SJCG.

iii) Product Report: ICC-ES Evaluation Report #ESR-1308, with Supplement to address compliance with 2019 California Building Code.

b. USG Interiors, Inc.; Donn DX/DXL Suspension System.

i) Edge Molding Clip at Free End of Runners and Tees: USG ACM7 Ceiling Attachment Clip.

ii) Seismic Joint Clips:

-Main Runners: USG Interiors, Inc.; Donn #DH2 with sliding face cap to match profile of runner.

-Cross Runners: USG Interiors, Inc.; Donn #DH4.

iii) Product Report: ICC-ES Evaluation Report #ESR-1222, with Supplement to address compliance with 2019 California Building Code.

c. Equal product in accordance with Division 1 requirements for product substitutions.

2. Structural Classification: Heavy-duty system, as defined in ASTM C 635.

3. End Condition of Cross Runners: Override (stepped) or butt-edge type.

4. Face Design: Flat, flush.

5. Cap Material: Steel cold-rolled sheet.

6. Cap Finish: Painted white

B. Seismic Separation Joints: Manufacturer's seismic joint clip for connecting ends of adjacent in-line runners while allowing 3/4-inch horizontal movement in either direction, in conformance with seismic design requirements. Provide sliding cover face cap to match profile and finish of adjacent runners.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Edge moldings shall fit lay-in panel edge details and suspension systems indicated, and match width and configuration of exposed runners, unless otherwise indicated.

a. Width of Exposed Flange of Edge Molding (Wall Angle): 2 inches

i) Provide manufacturer's standard retaining clip fabricated from cold-rolled hot-dip galvanized steel, which joins web of main runner or cross tee at ends to wall molding, while allowing 3/4-inch horizontal movement in either direction at free ends, in conformance with seismic design requirements.

2. For lay-in panels with reveal-edge profile, provide stepped-edge molding that forms reveal of same depth and width as that formed between edge of lay-in panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.8 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 07 92 00 “Joint Sealants.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which suspended lay-in panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of suspended lay-in panel ceilings.

B. Examine lay-in panels before installation. Reject panels that are wet, moisture-damaged, or mold-damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of lay-in panels to balance border widths at opposite edges of each ceiling, unless indicated otherwise on Drawings. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install suspended lay-in panel ceilings to comply with manufacturer’s written instructions and the following, as applicable to Seismic Design Categories D, E, and F:
1. California Building Code.
2. ASTM C 636.
3. ASTM E 580.
4. California Division of the State Architect Interpretation of Regulations IR 25-2.13, “Metal Suspension Systems for Lay-in Panel Ceilings: 2013 CBC.”
5. CISCA’s “Ceiling Systems Handbook.”
6. Fire-Rated Assembly: Install fire-rated ceiling systems according to referenced tested fire-rated design.

B. Suspend ceiling hangers from building’s structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

a. Separate all hanger wires at least 6 inches from unbraced ducts, pipes, conduits, and other construction above ceiling.

2. Space hangers not more than 48 inches on center along each member supported directly from hangers, unless otherwise indicated. Provide hangers not more than 8 inches from ends of each member, or within 1/4 of the length of the end runner, whichever is least, around the entire perimeter of the ceiling area.
   a. Provide additional hangers as required at all ceiling breaks, soffits, or discontinuous areas.
3. Splay hangers only where required to miss obstructions, offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   a. Hanger wires more than 1 in 6 out of plumb are to have countersloping wires.
      i) Countersloping is optional for perimeter hanger wires at main runners that are positively attached to perimeter closure angle.
4. Where ductwork, piping, equipment, and other construction within ceiling plenum interferes with location of hangers at required spacing, install supplemental suspension members and hangers in the form of trapezes or equivalent devices, so hanger wires do not attach to or bend around interfering construction.
5. Secure wire hangers to ceiling suspension members and to supports above by looping and wire tying with a minimum of three tight turns in 3 inches. Hanger wire loops shall be tightly wrapped and sharply bent to prevent vertical movement or rotation of the member within the loops. Connect hangers directly either to structures or to anchor clips, eye bolts, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures
   a. Direction of anchor clip leg, eye bolt, or other anchoring device to align as closely as possible with the direction of the hanger wire.
   b. At concrete, secure anchoring device for hanger wires with post-installed anchors or power-actuated fasteners.
6. Do not support ceilings directly from metal floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extends through metal deck and into concrete.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to ducts, pipe, or conduit.
9. Splicing of hanger wires is not permitted.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Provide bracing assemblies consisting of a compression strut and four splayed bracing wires oriented 90 degrees from each other. Place bracing assemblies at a spacing of not more than 12 feet by 12 feet on center.
   1. Provide bracing assemblies at locations at no more than 1/2 of the spacings indicated above, from each perimeter wall and at the edge of vertical ceiling offsets (e.g. where spacing is 8 feet, edge distance shall be a maximum of 4

feet from wall in direction of the 8-foot spacing; where spacing is 12 feet, edge distance shall be a maximum of 6 feet from wall in direction of the 12-foot spacing).

2. Provide additional bracing assemblies as required at all ceiling breaks, soffits, or discontinuous areas.
3. Configure or locate bracing wires so as to avoid obstructions while maintaining required maximum spacing of bracing assemblies. Bracing wires shall not attach to or bend around obstructions including but not limited to ductwork, piping, conduit, and equipment.
4. Secure bracing wires to ceiling suspension members and to supports by looping and wire tying with a minimum of four tight turns in 1-1/2 inches. Connect bracing wires directly either to structures or to anchor clips, eye bolts, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures. Do not attach to steel deck tabs. Fasten anchor clips for bracing wires into concrete with post-installed anchors (power-actuated fasteners are not allowed for bracing wires).
    a. Direction of anchor clip leg, eye bolt, or other anchoring device to align as closely as possible with the direction of the bracing wire.
5. Slope of bracing wires is not to exceed 45 degrees from the horizontal plane of the ceiling.
6. Bracing wires shall be taut.
7. Splicing of bracing wires is not permitted.
8. Separate all bracing wires at least 6 inches from unbraced ducts, pipes, conduits, and other construction above ceiling.
9. Compression struts to be adequate to resist vertical component of loads induced by bracing wires, and are not to be more than 1 (horizontal) in 6 (vertical) out of plumb.

D. Do not attach ends of suspended ceiling runners to more than two adjacent walls. Where end of runner is not attached to wall, provide 3/4 inch clear between end of runner and wall. If walls run diagonally to suspended ceiling runners, one end of main and cross runners shall be free, with a minimum 3/4 inch clearance between end of runner and wall.
    1. At those portions of ceiling perimeter in which main or cross runners are not attached to wall, provide a seismic stabilizer bar for interconnection between adjacent runners at free end to prevent lateral spreading.
        a. If perpendicular distance from wall to first parallel runner is 8 inches or less, interconnection of free ends of perpendicular runners is not required.
        b. Where manufacturer’s retaining clip designed to join main runner or cross tee to wall molding while allowing 3/4-inch horizontal movement in either direction is used, seismic stabilizer bar for interconnection of adjacent runners is not needed.

E. Install edge moldings and trim of type indicated at perimeter of suspended ceiling area and where necessary to conceal edges of lay-in panels.
    1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches on center and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

G. Mount all light fixtures, air terminals, and other devices and services in ceiling as follows:
1. Light fixtures, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with ASCE 7, as amended by the California Building Code and ASTM E 580.
2. Ceiling panels shall not support any light fixtures, air terminals, or devices.
3. Attach all light fixtures, air terminals, and other devices and services in ceiling to ceiling suspension system main runners (Heavy-Duty classification) to resist a horizontal force equal to the weight of the fixture, terminal, or device, using screws or other approved fasteners. Minimum of two attachments are required at each fixture, terminal, or device.
4. Light Fixtures:
   a. Support surface-mounted light fixtures by at least two positive metal clamping devices of 14-gage minimum thickness which completely surrounds the ceiling runner and which are each connected to a 12-gage slack safety wire anchored to structure above. Spring clips or clamps and rotational spring catches that connect only to the runner are not acceptable. Provide additional supports when light fixtures are 8 feet long or longer or exceed 56 lbs. Maximum spacing between supports shall not exceed 8 feet
   b. Light fixtures weighing less than or equal to 10 lbs shall be provided with a minimum of one 12-gage slack safety wire connected to the fixture housing and anchored to structure above.
   c. Light fixtures weighing more than 10 lbs and less than or equal to 56 lbs, except as noted below, may be supported directly on main runners of a Heavy-Duty classification suspended ceiling system, but shall be provided with a minimum of two 12-gage slack safety wires at diagonally opposite corners, each connected to the fixture housing and anchored to structure above.
      i) Light fixtures greater in size than 2 feet by 4 feet, weighing less than 56 lbs shall be provided with 12-gage slack safety wires at each corner.
   d. Light fixtures weighing 56 lbs or more shall be independently supported by not less than four 12-gage taut safety wires, each connected to the housing and anchored to the structure above. The four taut safety wires shall be capable of supporting four times the weight of the unit.
5. Services Within Ceiling:
   a. Flexible sprinkler hose fittings, air terminals, and other services in ceiling weighing less than or equal to 20 lbs shall be provided with a minimum of

one 12-gage slack safety wire connected to unit and anchored to structure above.

b. Flexible sprinkler hose fittings, air terminals, and other services in ceiling weighing more than 20 lbs and less than or equal to 56 lbs shall be provided with a minimum of two 12-gage slack safety wires at diagonally opposite corners, each connected to unit and anchored to structure above.

c. Flexible sprinkler hose fittings, air terminals, and other services in ceiling weighing more than 56 lbs shall be independently supported by not less than four 12-gage taut safety wires, each connected to unit and anchored to structure above. The four taut safety wires shall be capable of supporting four times the weight of the unit.

6. Support pendant-mounted light fixtures directly from structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two times the weight of the fixture. Provide bracing assembly, as specified above, where pendants penetrate ceiling. Bracing assembly to be positively connected to pendant as required to transmit horizontal forces, so that pendant does not impose any lateral force on suspended ceiling system.

7. Attach all lightweight miscellaneous devices, including fire alarm strobes, smoke detectors, speakers, exit signs, etc. to ceiling grid main runners (Heavy-Duty classification) to resist a horizontal force equal to the weight of the device, using screws or other approved fasteners. Minimum of two attachments are required at each device. Devices weighing more than 10 lbs shall be provided with a 12-gage slack safety wire connected to device and anchored to structure above. Devices weighing more than 20 lbs shall be independently supported from structure as detailed on Drawings.

H. Provide seismic separation/expansion joints in ceiling areas as follows:

1. As required to divide overall ceiling area into individual areas not exceeding 2500 square feet.

2. In ceiling areas at intersections of corridors, and at junctions of corridors and lobbies or other similar areas.

3. At penetrations through ceiling for sprinkler heads and other similar devices that are not integrally tied to ceiling system in the lateral direction, provide one of the following methods to accommodate movement:

a. 2-inch oversized ring, sleeve, or adapter through ceiling tile to allow free movement of 1 inch in all horizontal directions.

b. Flexible sprinkler hose fitting that can accommodate 1 inch of ceiling movement in any lateral direction.

I. Install lay-in panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned lay-in panels as follows:

a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
5. Install hold-down clips in areas indicated. Space according to lay-in panel manufacturer's written instructions unless otherwise indicated.
6. Install clean-room gasket system in areas indicated, sealing each panel and fixture as per panel manufacturer's written instructions.
7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

A. Owner will engage a qualified special inspector to perform the following special inspections:
   1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

B. Testing Agency: Project Inspector will perform tests and inspections and prepare test reports.
   1. Notify Project Inspector at least 2 working days in advance of the time when Work that requires testing or inspecting is to be performed.
   2. Provide access to the Work as needed to perform testing and inspecting.

C. Testing and Inspection: Testing and inspecting of completed installations of suspended lay-in panel ceiling hangers and anchors and fasteners shall take place in successive stages. Do not proceed with installations of suspended lay-in panel ceiling hangers for the next area until test results for previously completed installations of suspended lay-in panel ceiling hangers show compliance with requirements.
   1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
      a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and post-installed anchors used to attach hangers to concrete and will test them for 200 lbf of tension. It will also select one of every two post-installed anchors used to attach bracing wires to concrete and will test them for required tension or torque loads as required by California Building Code.
      b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Remove and replace suspended lay-in panel panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.
   1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING

A. Clean exposed surfaces of suspended lay-in panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 65 00

RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Commercial Resilient Flooring

B. Related Sections include:
   1. Section 09 05 65 “Concrete Moisture-Control System” for moisture-vapor-emission control system applied to concrete slab substrates prior to installation of finish flooring.
   2. Section 09 65 13 “Resilient Base and Accessories” for resilient base, stair treads, and transition moldings.

1.3 REFERENCES

A. ASTM International:
   1. ASTM D 2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
   2. ASTM D 2240: Standard Test Method for Rubber Property-Durometer Hardness.
   3. ASTM D 6866: Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis.
   4. ASTM E 648: Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
   5. ASTM E 662: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
   6. ASTM F 710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   7. ASTM F 970: Standard Test Method for Static Load Limit.
   8. ASTM F 1700: Standard Specification for Solid Vinyl Floor Tile.
   9. ASTM F 2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

B. California Air Resources Board:
   1. Suggested Control Measure for Architectural Coatings.

C. California Collaborative for High Performance Schools (CA-CHPS).

D. California Code of Regulations – Title 17, Public Health.

E. California Department of Public Health (CDPH):
   1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

F. California Green Building Standards Code (CALGreen) – California Code of Regulations, Title 24, Part 11.

G. Chemical Abstract Service (CAS):
   1. Chemical Abstract Registration Number (CASRN).

H. Cradle to Cradle Products Innovation Institute:
   1. Cradle to Cradle Certified Product Standard.

I. European Standards (EN):
   1. EN 15804: Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products.

J. GreenScreen for Safer Chemicals:
   1. GreenScreen Chemical Hazard Assessment Procedure V1.2.

K. Health Product Declaration Collaborative:
   1. Health Product Declaration Open Standard.

L. International Organization for Standardization (ISO):
   1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).
   2. ISO 14025: Environmental Labels and Declarations – Type III Environmental Declarations – Principals and Procedures.
   3. ISO 14040: Environmental Management – Life Cycle Assessment – Principals and Framework.
   4. ISO 14044: Environmental Management – Life Cycle Assessment – Requirements and Guidelines.
   5. ISO 21930: Sustainability in Building Construction – Environmental Declaration of Building Products.

M. Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

N. Resilient Floor Covering Institute (RFCI):
   1. FloorScore certification program.

O. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1113 – Architectural Coatings.
   2. Rule 1168 – Adhesive and Sealant Applications.

P. Sustainable Agriculture Network:
   1. Sustainable Agriculture Standard.

Q. UL Environment:

1. GREENGUARD Gold certification program.

1.4 DEFINITIONS

A. VOC: Volatile Organic Compounds.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include documentation of test results for slip resistance.

B. Shop Drawings:
   1. Sheet: For each type of sheet flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
      a. Show details of special patterns.

C. Samples for Verification:
   1. Floor Tile: Full-size units of each color and pattern of resilient floor tile.

D. CALGreen Submittals:
   1. Manufacturer's product data for resilient flooring products indicating compliance with product requirements specified in "CALGreen Requirements" Article.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient flooring product and accessory to include in maintenance manuals.

1.8 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. Sheet Flooring: Furnish 10 linear feet for every ***[500]*** linear feet, or fraction thereof, in roll form and in full roll width for each type, color, and pattern of sheet flooring installed.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for installation of resilient flooring.
   1. Engage an Installer who employs workers for this Project that are trained or certified by resilient flooring manufacturer for installation techniques required.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store resilient flooring products, and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F, except not less than 65 deg F for linoleum.
   1. Store tiles on flat surfaces.

1.11 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient flooring during the following time periods:
   1. 48 hours before installation, except as noted below:
      a. 72 hours before installation for sheet flooring.
   2. During installation.
   3. 48 hours after installation, except as noted below:
      a. 72 hours after installation for sheet flooring.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Moisture content of concrete slabs and environmental conditions must be within limits recommended by manufacturer of products being installed.

D. Close spaces to traffic during resilient flooring installation.

E. Close spaces to traffic for 48 hours after resilient flooring installation, except as noted below:
      a. 72 hours after installation for linoleum tile and sheet flooring.

F. Install resilient flooring after other finishing operations, including painting, have been completed.

1.12 WARRANTY

A. Provide manufacturer’s standard limited warranty

PART 2 - PRODUCTS

2.1 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Provide adhesives and adhesive primers which comply with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule 1168, except as noted otherwise below. Such products shall also comply with Rule 1168 prohibition of the use of certain toxic compounds (chloroform, ethylene, dichloride, methylene chloride, perchloroethylene, and trichloroethyelen).
   1. Aerosol adhesives and similar unit sizes of adhesives, and sealants (in units of product, less packaging, which do not weigh more than one pound and do not consist of more

than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions of use of certain toxic compounds, of the California Code of Regulations, Title 17, commencing with Section 94507.

C. Resilient Flooring: Provide resilient flooring products which meet at least one of the following:
   1. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program.
   2. Compliant with the VOC-emission limits specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010.
   3. Compliant with 2014 California Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) and listed in the CHPS High Performance Database.
   4. Certified under UL Environment GREENGUARD Gold certification program (formerly Greenguard Children's & Schools Program).

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics for Resilient Flooring:
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq cm, as determined by testing identical products according to ASTM E 648.
   2. Smoke Density: 450 or less, determined by testing identical products according to ASTM E 662.

B. Slip-Resistance:
   1. Except where indicated otherwise, provide resilient flooring products with a minimum Coefficient of Friction of 0.6 as tested under dry conditions in accordance with ASTM D 2047.
      a. Application of floor polish is not to reduce Indicated Coefficient of Friction values below indicated minimums.

2.3 Commercial Resilient Flooring

1	Product Name:	wineo PURline by Mats Inc.
2	ASTM Specification: ASTM Specification currently under development	Unclassified commercial flooring
3	Limited Wear Warranty:	10 years
4	Material:	Botanol
5	Composition:	Heterogeneous bio-polyurethane, glass fiber reinforcement, paper print layer and PU top coat
6	Color:	Standard colors as offered
7	Surface:	Depending on design
8	Back of Sheet:	FleeceTEC system®
9	Material Size:	6'7" x 65'7" x 2.5mm

10	Flammability (E648/NFPA 253): ≥ 0.45 watts/sq. cm. for Class 1 is required	Meets Class 1
11	Smoke Density (ASTM E662/NFPA 258): < 450 is required	Meets requirements
12	Slip Resistance (ASTM D2047):	Dry 0.92 and wet 0.93 (not recommended for ramps)
13	VOC's:	CA 01350 compliant
14	Hardness (ASTM D2240):	Shore type "A", > 95
15	Static Load (ASTM F970): ≤ 0.005 inches is required under 175 lbs.	Meets requirement under 1450 lbs.
16	Substrate Preparation:	Per ASTM F710 and the wineo PURline by Mats Inc. installation instructions

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement-based or blended hydraulic-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.

B. Primer/Sealer: Resilient flooring manufacturer's standard sealer material designed to seal gypsum-based underlayment surfaces.

C. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.

1. VOC Content: Complies with requirements specified in "CALGreen Requirements" Article

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer of resilient flooring and accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, maximum moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might show through surface of or interfere with adhesion of resilient flooring and accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL CONTRACTOR RESPONSIBILITIES

A. Supply a safe, climate controlled building and subfloor that meets the requirements of *ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring* or as detailed in the wineo PURline by Mats Inc. installation instructions. This includes a structurally sound concrete subfloor, new concrete slabs must conform to *ASTM C33/C33M — Standard Specification for Concrete Aggregate*.

B. On and below grade concrete subfloors require a confirmed effective vapor retarder with a low permeance (≤ 0.1) having a minimum thickness of 10 mils or meeting the requirements of *ASTM E1745 — Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*. Confirm it was placed directly underneath the concrete, above the granular fill. If this is not possible, use a topically applied moisture mitigation system that conforms to *ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings.* It must be applied following the manufacturers written instructions. Chemical adhesive removers must not be used.

C. Moisture testing is mandatory following the protocol of *ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Slabs using in situ Probes*, regardless of grade level or whether the concrete is freshly poured or classified as an older slab. It is the responsibility of the General Contractor/End User to have the concrete subfloor tested for moisture. It is also recommended that an International Concrete Repair Institute (ICRI) Tier 2 Certified Technician performs the moisture testing. The test results must not exceed the maximum acceptable relative humidity for the adhesive. If they do, the installation must not proceed until either the subfloor dries to an acceptable level or an effective mitigation system is used that conforms to *ASTM F3010* installed following the manufacturer's written instructions. The test methodology and results including photographs must be documented and provided to the flooring contractor, General Contractor, owner and/or architect.

D. A secure storage and/or installation area that is maintained permanently or temporarily at the required ambient service temperature and humidity, so the flooring contractor can acclimate the flooring materials is required for at least 48 hours prior to, during and 72 hours after the application of the flooring.

E. Areas with direct prolonged exposure to sunlight must be protected with the use of Low E glass doors and windows, facades or use a protective film over the glass.

F. Areas of the flooring that are subject to direct sunlight through doors or windows should have them covered using blinds, curtains, cardboard or similar for the time of the installation and 72hours after the installation to allow the adhesive to cure.

G. Prevent all traffic for a minimum of 12 hours and rolling loads for 72 hours to allow the adhesive to cure. If required after 12 hours protect the flooring from damage during construction operations using Masonite, plywood or a similar product, ensuring first that the flooring surface is free of all debris. Lay panels so that the edges form a butt joint and tape the joint to prevent both movement and debris entrapment underneath them. Inspect immediately before covering and after removal for final acceptance.

3.3 FLOORING CONTRACTOR RESPONSIBILITIES

A. Provide professional flooring installers experienced at installing commercial resilient floor coverings with sufficient professional liability insurance coverage (aka Errors and Omissions Insurance) for the project.

B. Provide an effective installation manager to manage the project and installers and ensure that all of the required procedures are followed as detailed in the wineo PURline by Mats Inc. or approved equal installation instructions. This includes obtaining the moisture test results (from GC/EU) and making sure they are acceptable prior to installing the flooring.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient flooring.

B. Perform the following operations immediately after completing resilient flooring installation:
   1. Remove adhesive and other blemishes from exposed surfaces using cleaner recommended by resilient product manufacturers.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.
      a. Do not wash floor until after time period recommended by manufacturer.

C. Protect resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer of resilient flooring.

D. Cover resilient flooring surfaces until Substantial Completion.
   1. Allow drying room film (yellow film caused by linseed oil oxidation) to disappear, before covering linoleum surfaces.

E. Do not move heavy and sharp objects directly over surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels

END OF SECTION 09 65 00

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Resilient base.

B. Related Sections include:
   1. Section 09 65 00 ”Resilient Flooring” for resilient flooring installed with resilient base.
   2. Section 09 68 13 “Tile Carpeting” for carpet tile flooring installed with resilient base

1.3 REFERENCES

A. ASTM International:
   1. ASTM F 710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   2. ASTM F 1861: Standard Specification for Resilient Wall Base.
   3. ASTM F 2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

B. California Code of Regulations – Title 17, Public Health.

C. California Department of Public Health (CDPH):
   1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

D. California Green Building Standards Code (CALGreen) – California Code of Regulations, Title 24, Part 11.

E. Resilient Floor Covering Institute (RFCI):
   1. FloorScore certification program.

F. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications.

G. UL Environment:
   1. GREENGUARD Gold certification program.

H. United States Department of Justice:
   1. 2010 ADA Standards for Accessible Design.

1.4 DEFINITIONS

A. VOC: Volatile Organic Compounds.

1.5 ACTION SUBMITTALS

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

B. Samples for Verification:

1. Resilient Base: Manufacturer's standard size Samples, but not less than 12 inches long, of each resilient base color, texture, and pattern.

C. CALGreen Submittals:

1. Manufacturer's product data for resilient flooring products indicating compliance with product requirements specified in "CALGreen Requirements" Article.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Base: Not less than 10 linear feet for every ***[500]*** linear feet, or fraction thereof, of each type, color, pattern, and size of resilient base installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for installation of resilient base and accessories.

1. Engage an Installer who employs workers for this Project that are trained or certified by resilient flooring and accessory manufacturer for installation techniques required.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for each type of resilient base and accessory.

a. Size: Minimum ***[10]*** lineal feet for each type, in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store resilient base and accessories, and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient base and accessories during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient base and accessories after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Provide adhesives and adhesive primers which comply with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule 1168, except as noted otherwise below. Such products shall also comply with Rule 1168 prohibition of the use of certain toxic compounds (chloroform, ethylene, dichloride, methylene chloride, perchloroethylene, and trichloroethyelen).

1. Aerosol adhesives and similar unit sizes of adhesives, and sealants (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions of use of certain toxic compounds, of the California Code of Regulations, Title 17, commencing with Section 94507.

C. Resilient Base and Accessories: Provide resilient products which meet at least one of the following:

1. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program.
2. Compliant with the VOC-emission limits specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010.
3. Certified under UL Environment GREENGUARD Gold certification program (formerly Greenguard Children’s & Schools Program).

2.2 RESILIENT BASE

A. Resilient Base Standard: ASTM F 1861.

1. Manufacturer: Subject to compliance with requirements, provide resilient base by one of the following:

a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.

b. Roppe Corporation, USA.

c. Manufacturer of equal products, in accordance with Division 1 requirements for product substitutions.

2. Color***[s]***: As specified in Section 09 06 00 “Colors and Finishes.”

B. Material Requirement: TS (rubber, vulcanized thermoset).

C. Manufacturing Method: Group I (solid, homogeneous).

D. Style: Cove (base with toe).

E. Minimum Thickness: 0.125 inch.

F. Height: 4 inches.

G. Lengths: Coils in manufacturer’s standard length.

H. Outside Corners: Job formed, except use preformed where indicated in Part 3.

I. Inside Corners: Job formed.

J. Finish: Matte.

K. Surface: Smooth.

L. VOC Emissions:

1. Complies with requirements specified in “CALGreen Requirements” Article.

2. Certification: RFCI FloorScore.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement-based or blended hydraulic-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.

1. VOC Content: Complies with requirements specified in “CALGreen Requirements” Article.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, maximum moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might show through surface of or interfere with adhesion of resilient flooring and accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resilient base and accessory manufacturer's written recommendations to ensure adhesion of resilient products.

B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring and accessory manufacturer. Do not use solvents.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners: Except as noted otherwise below, install job-formed corners.

1. Outside Corners: Use straight pieces of maximum lengths possible, and form with returns not less than 3 inches in length. Form without producing discoloration (whitening) at bends.
    a. Where project conditions are such that length of base on either side of corner is less than 3 inches, notch back of toe of resilient wall base to facilitate bending around corner, and ensure full coverage is achieved with adhesive at backside of base. Entire length of base shall be tightly adhered.
2. Inside Corners: Use straight pieces of maximum lengths possible, and form with returns not less than 3 inches in length. Form by cutting an inverted V-shaped notch in toe of wall base at point where corner is formed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient base and accessories.

B. Perform the following operations immediately after completing resilient base installation:

1. Remove adhesive and other blemishes from exposed surfaces using cleaner recommended by resilient product manufacturers.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.
    a. Do not wash surfaces until after time period recommended by manufacturer.

C. Protect resilient base from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 65 13

SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes modular carpet tile.

B. Related Sections include:

1. Section 01 74 19 “Construction Waste Management and Disposal” for recycling of existing carpet materials to be removed.
2. Section 02 41 19 “Selective Demolition” for removal of existing floor coverings.
3. Section 09 05 65 “Concrete Moisture-Control System” for moisture-vapor-emission control system applied to concrete slab substrates prior to installation of finish flooring.
4. Section 09 65 13 “Resilient Base and Accessories” for the following resilient products used with carpet tile:
    a. Resilient base.

1.3 REFERENCES

A. American Association of Textile Chemists and Colorists (AATCC):

1. AATCC 16: Test Method for Colorfastness to Light.
2. AATCC 134: Test Method for Electrostatic Propensity of Carpets.

B. ASTM International:

1. ASTM E648: Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
2. ASTM E662: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
3. ASTM D7570: (Edge Curl) Standard Test Method for Evaluating Dimensional Stability of Pile Yarn Floor Covering
4. ASTM D2859: Surface Flammability of Carpets and Rugs (16 CFR Chapter II, Subchapter D, Part 1630 CPSC FF 1-70)

C. CALGreen: California Green Building Standards Code - California Code of Regulations, Title 24, Part 11.

D. NSF International/American National Standards Institute (ANSI):

1. NSF/ANSI 140: Sustainability Assessment for Carpet.

E. South Coast Air Quality Management District (SCAQMD):

1. Rule 1168 – Adhesive and Sealant Applications.

1.4 DEFINITIONS

A. VOC: Volatile Organic Compounds.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
      a. Delivery, storage, and handling procedures.
      b. Ambient conditions and ventilation procedures.
      c. Subfloor preparation procedures.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Existing flooring materials to be removed.
   3. Existing flooring materials to remain.
   4. Carpet tile type, color, and dye lot.
   5. Type of subfloor.
   6. Type of installation.
   7. Pattern of installation.
   8. Pattern type, location, and direction.
   9. Pile direction patterns.
   10. Type, color, and location of edge, transition, and other accessory strips.
   11. Transition details to other flooring materials.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

E. CALGreen Submittals:
   1. Manufacturer's product data for adhesives and adhesive primers indicating compliance with product requirements specified in "CALGreen Requirements" Article.

2. Manufacturer's product data for carpet tile indicating compliance with product requirements specified in "CALGreen Requirements" Article.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq yds.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockups at locations and in sizes as shown on Drawings or if not shown, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.12 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until wet work in spaces is complete and dry and ambient temperature and humidity conditions are maintained at occupancy levels planned for building occupants during the remainder of the construction period.

1.13 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, the following:
      a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
      b. Dimensional instability.
      c. Loss of tuft-bind strength.
      d. Excess static discharge.
      e. Loss of face fiber.
      f. Delamination
   3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Provide adhesives and adhesive primers which comply with current VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule 1168, except as noted otherwise below. Such products shall also comply with Rule 1168 prohibition of the use of certain toxic compounds (chloroform, ethylene, dichloride, methylene chloride, perchloroethylene, and trichloroethyelen).
   1. Aerosol adhesives and similar unit sizes of adhesives, and sealants (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions of use of certain toxic compounds, of the California Code of Regulations, Title 17, commencing with Section 94507.

C. Carpet Tile: Provide carpet tile products which meet at least one of the following:
   1. Certified as complying with the testing and product requirements of the Carpet and Rug Institute's Green Label Plus program.
   2. Compliant with the VOC-emission limits specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010.
   3. Meets requirements of NSF/ANSI 140 for certification at the Gold level or higher.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics for Tile Carpeting:
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq cm, as determined by testing identical products according to ASTM E648.

2. Smoke Density: 450 or less, determined by testing identical products according to ASTM E662.

2.3 CARPET TILE

A. Modular Carpet Tile - Type 1: Modular carpet tile system designed for random installation, such that individual tiles may be installed without regard to pile direction, pattern, or orientation while maintaining a visually continuous and finished overall appearance without any tile appearing improperly positioned.

1. Product: Masland; Diminishing Grid
    a. Color: As specified in Section 09 06 00 “Colors and Finishes.”
2. Construction: Tufted.
3. Fiber Content: 100 percent nylon Type 6, 6.
4. Dye Method: 100 percent solution dyed.
5. Pile Characteristic: Tip-sheared.
6. Pile Height: .281 inch.
7. Gauge: 1/12 inch.
8. Face Yarn Weight: 22 oz per sq yd.
9. Primary Backing/Backcoating: Non-woven fiberglass-reinforced PVC.
10. Secondary Backing: EarthWise (non-phthalate, contains recycled content).
11. Size: 24 inch by 24 inch (576 inches square).
12. Applied Soil-Resistance Treatment: Manufacturer’s standard material
13. Performance Characteristics: As follows:
    a. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option 3.
    b. Electrostatic Propensity: Less than 3.0 kV per AATCC 134.
14. Minimum Recycled Content:
    a. Preconsumer: 38 percent.
    b. Postconsumer: 10 percent.
15. VOC Emissions:
    a. Complies with requirements specified in “CALGreen Requirements” Article.
    b. Certification: CRI Green Label Plus.

B. Modular Carpet Tile - Type 2: Modular carpet tile system designed for random installation, such that individual tiles may be installed without regard to pile direction, pattern, or orientation while maintaining a visually continuous and finished overall appearance without any tile appearing improperly positioned.

1. Product: Masland; Subtle Impact
    a. Color: As specified in Section 09 06 00 “Colors and Finishes.”
2. Construction: Tufted.
3. Fiber Content: 100 percent nylon Type 6, 6.
4. Dye Method: 100 percent solution dyed.

5. Pile Characteristic: Tip-sheared.
6. Pile Height: .281 inch.
7. Gauge: 1/12 inch.
8. Face Yarn Weight: 22 oz per sq yd.
9. Primary Backing/Backcoating: Non-woven fiberglass-reinforced PVC.
10. Secondary Backing: EarthWise (non-phthalate, contains recycled content).
11. Size: 24 inch by 24 inch (576 inches square).
12. Applied Soil-Resistance Treatment: Manufacturer's standard material
13. Performance Characteristics: As follows:
    a. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option 3.
    b. Electrostatic Propensity: Less than 3.0 kV per AATCC 134.
14. Minimum Recycled Content:
    a. Preconsumer: 38 percent.
    b. Postconsumer: 10 percent.
15. VOC Emissions:
    a. Complies with requirements specified in "CALGreen Requirements" Article.
    b. Certification: CRI Green Label Plus.

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Primer/Sealer: Carpet manufacturer's standard sealer material designed to seal gypsum-based underlayment surfaces.

C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
    1. VOC Content: Complies with requirements specified in "CALGreen Requirements" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Verify that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might show through surface or interfere with adhesion of carpet tile and accessories

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Concrete substrates: Prepare according to ASTM F 710.

1. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturer.
2. Moisture and Alkalinity Testing: Perform tests recommended by carpet tile manufacturer and as follows. Proceed with installation only after substrates pass testing.
    a. Perform concrete moisture testing, using the relative humidity in-situ probe test method, in accordance with ASTM F 2170.
        i) Proceed with installation only after substrates show a moisture level of 75 percent relative humidity or less, or as recommended in writing by manufacturer of carpet tile to be installed.
    b. Perform alkalinity testing in accordance with ASTM F 710.
        i) Proceed with installation only after substrates show a pH level of not less than 7 and not greater than 9, or as recommended in writing by manufacturer of carpet tile to be installed.

or

3. Refer to Section 09 05 65 "Concrete Moisture-Control System" for moisture and alkalinity testing and treatment. Proceed with installation only after substrates pass testing.
4. Adhesion Testing: Perform tests recommended by carpet tile manufacturer. Proceed with installation only after substrates pass testing.

C. Metal Substrates: Clean grease, oil, soil, and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

D. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes, and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

E. Apply primer/sealer over gypsum-based cementitious underlayment in accordance with carpet manufacturer's written instructions and as required to ensure proper adhesion of carpet to underlayment surface.

F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 CARPET TILE INSTALLATION

A. General: Comply with CRI's "Carpet Installation Standard," Section 18, "Modular Carpet," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer, and as follows:

1. Glue-down; install every tile with full-spread, releasable pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Maintain carpet tile patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Do not bridge building expansion joints with carpet tiles.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile.

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "CRI Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 81 16

ACOUSTICAL BLANKET INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Acoustical blanket (batt) insulation for sound attenuation in interior partitions.

B. Related Sections include:
   1. Section 07 84 43 “Joint Firestopping” for insulation installed as part of a fire-resistive joint system.
   2. Division 23 Section for HVAC duct insulation.

1.3 REFERENCES

A. ASTM International:
   1. ASTM C 665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
   2. ASTM C 764: Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation.
   3. ASTM C 1320: Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
   4. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.

B. California Department of Public Health (CDPH):
   1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

C. European Standards (EN):
   1. EN 15804: Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products.

D. International Organization for Standardization (ISO):
   1. ISO 14021: Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling).
   2. ISO 14025: Environmental Labels and Declarations – Type III Environmental Declarations – Principals and Procedures.
   3. ISO 14040: Environmental Management – Life Cycle Assessment – Principals and Framework.

4. ISO 14044: Environmental Management – Life Cycle Assessment – Requirements and Guidelines.
5. ISO 21930: Sustainability in Building Construction – Environmental Declaration of Building Products.

E. UL Environment:
1. GREENGUARD Gold certification program.

F. Underwriters Laboratories (UL).
1. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Formaldehyde-Free Product: Acoustical blanket insulation shall be certified by manufacturer to be formaldehyde-free.

B. Fire-Test-Response Characteristics: Acoustical blanket insulation shall comply with the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL BLANKET INSULATION

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation; NoiseReducer Sound Attenuation and Acoustical Ceiling Batts.
b. Johns Manville, a Berkshire Hathaway Company; Unfaced Insulation.
c. Knauf Insulation; EcoBatt Unfaced.
d. Owens Corning; EcoTouch Sound Attenuation Batts.

e. Manufacturer of equal products in accordance with Division 1 requirements for product substitutions.

2.3 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gemco.

b. GLT Products.

c. Stud Welding Products, Inc.

d. Manufacturer of equal products in accordance with Division 1 requirements for product substitutions.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch by 2 inches square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed, 0.105 inch in diameter; length to suit depth of insulation.

4. Insulation-Retaining Washers: Self-locking washers from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

5. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

6. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

B. Nails and Staples: Steel wire; electroplated or galvanized; type and size to suit application.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that are harmful to acoustical insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.3 INSTALLATION OF BLANKET INSULATION

A. Comply with acoustical insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install acoustical insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend acoustical insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Install acoustical blanket insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For wood-framed construction, install blanket insulation according to ASTM C 1320 and as follows:

F. Anchor Installation: Where acoustical blanket insulation is installed on spindle-type anchors, fasten anchors to substrate with insulation anchor adhesive according to manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.

1. After anchor adhesive has dried, install insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
2. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

G. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu ft.

3.4 PROTECTION

A. Protect installed acoustical insulation from damage due to physical abuse and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.5 ACOUSTICAL BLANKET INSULATION SCHEDULE

A. Install acoustical blanket (batt) insulation as follows, where indicated on Drawings:

1. Metal Framing:

a. 3-5/8-Inch Deep Stud Framing: R-13 (3-1/2-inch thick batts).

b. 5-1/2-Inch Deep Stud Framing: R-20 (5-1/2-inch thick batts).

c. 6-Inch Deep Stud Framing: R-20 (5-1/2-inch thick batts).

END OF SECTION 09 81 16

SECTION 09 83 19

DECORATIVE ACOUSTICAL WALL PANELS

PART 1–GENERAL

1.1 RELATED DOCUMENTS

General conditions and shop drawings of Contract, including General and Supplementary Conditions including Division-1 sections should they apply to the work of this section.

1.2 SUMMARY

A. Section Includes:
   1. Wall panels, unfinished or prefinished decorative acoustical wall panels, and components.

B. Substitutions
   1. Submittals which do not provide adequate product information required in the specification will not be considered. The proposed substitution shall meet all requirements of this section to be considered.

1.3 REFERENCES

A. Test Methods:
   1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
   3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   4. California Special Environmental Requirements Specification Section 01350 Protocol: Standard Practice for Testing of Volatile Organic Emissions from Various Sources using Small-Scale Environmental Chamber CA/DHS/EHLB/R-174.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data for each type of wall panel required.

B. Samples: For each specified wall panel, submit 6-inch by 6-inch samples of panels.

C. Certifications: Submit copies of independent third-party certifications which meet specified requirements and related certified independent laboratory reports showing compliance with specified tests and standards.

D. Shop Drawings: Submit shop drawings indicating wall panel layout, required trim, and seam locations for this project.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10 years of experience in producing bamboo wall panel products.

B. Emissions Levels: Where indicated in Division 1 and, or Part 2, Products, quality assurance includes a copy of the laboratory letter verifying the product has been tested per California Special Environmental Requirements Protocol.

1.6 DELIVERY, STORAGE AND HANDLING

A. Wall panels are to be delivered to the project site in original, unopened packages and must be protected from moisture, direct sunlight, and damage.

B. Storage temperatures should not be different from normal conditions of an occupied space, between 50 degrees F and 80 degrees F, with relative humidity between 30 - 50 percent.

C. Before installing wall panels, allow to achieve room temperature of the conditioned environment.

1.7 WARRANTY

A. Submit a written warranty from the manufacturer available at:
http://www.plyboo.com/downloads/smith-fong-plywood-warranty

1.8 MAINTENANCE

A. Extra Materials:
1. Wall Panels: Furnish extra quantity of units equal to 5.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wall Panels:
1. Manufacturer: Smith & Fong Company
   a. 475 Sixth Street, San Francisco, CA 94103
   b. Telephone: 415-896-0577
   c. Website: www.plyboo.com

2.2 WALL PANELS

A. Wall Panels: Type AWP-1:
1. Material: 100% Bamboo (FSC Certified)
2. Surface Texture: Smooth
3. Surface Type: Species: Moso bamboo (Phyllostachys Pubescens)
4. Base/Core Composition: REALCORE™; Species: Moso bamboo (Phyllostachys Pubescens)
5. Sound Absorption: QuietWall™ Technology
6. Color: (Amber) or (Natural)
7. Patterns: (A-1) (A-2) (A-3) (A-4) (A-5) (A-6) (A-7)
8. Standards/Certifications: (CARB II) (FSC 100%)
9. Thickness: ¾-inch (19mm)
10. Width:47-1/2 inches (1206mm)
11. Panel Heights:95-1/2 inches (2426mm)
12. Edge Profile: Straight edge
13. Noise Reduction Coefficient (NRC): ASTM C 423: avg. 0.50
14. Sound Transmission Class (STC): ASTM E 795A: Rating 0.00
    a. 43 – Wall Panel on one side of 5/8” drywall on 3-5/8” metal studs
    b. 46 – Wall Panel on two sides of 5/8” drywall on 3-5/8” metal studs
    c. 52 - Wall Panel on one side of 5/8” drywall on 3-5/8” metal studs with R-11 fiberglass insulation in cavity

15. Flame Spread: ASTM E84; Class C (Class B available).
16. Emission Testing: Section 01350 Protocol: No VOC's with chronic REL's (reference exposure level) detected, passes office, school and residential.
17. Dimensional Stability: Standard – space must be enclosed with HVAC systems operating and with appropriate humidity levels maintained between 30%RH-50%RH at all times.
18. Acceptable Product: Plyboo Sound Panel, as manufactured by Smith & Fong Company.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All wet work such as concrete, terrazzo, plastering and painting must be completed and thoroughly dried out before installing the product specified, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure the wall area(s) and establish layout of wall panel units per shop drawings and to ensure border widths are balanced at opposite edges. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install wall panels by attaching the panels to an existing wall per the manufacturer's instructions and in accordance with the authorities having jurisdiction.

B. Install panels using a standard Z-clip system.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Perform routine maintenance involving frequent vacuuming to mitigate dirt accumulation. When needed, clean with a damp (not wet) cloth.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the field application of paint systems as specified in Paint Systems Schedules at the end of this Section.
   1. Backpriming of finish carpentry work is included in this Section.

B. Related Sections include:
   1. Section 05 12 00 ”Structural Steel” for shop priming of structural steel.
   2. Section 05 50 00 ”Metal Fabrications” for shop priming of metal fabrication items.
   3. Section 08 11 13 ”Hollow-Metal Doors and Frames” for shop priming of hollow-metal steel doors and frames to receive field painted finish.

1.3 REFERENCES

A. ASTM International:
   1. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
   2. ASTM D 523: Standard Test Method for Specular Gloss.

B. California Air Resources Board:
   1. Suggested Control Measure for Architectural Coatings.

C. California Department of Public Health (CDPH):
   1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

D. California Green Building Standards Code (CALGreen) – California Code of Regulations, Title 24, Part 11.

E. Master Painters Institute (MPI):
   1. MPI Architectural Painting Specification Manual.
   2. MPI Maintenance Repainting Manual.

F. Society for Protective Coatings (SSPC):
   1. SSPC-PA 1: Shop, Field, and Maintenance Painting of Steel.
   2. SSPC-SP 2: Hand Tool Cleaning.
   3. SSPC-SP 3: Power Tool Cleaning.

G. South Coast Air Quality Management District (SCAQMD):

1. Rule 1113 – Architectural Coatings.
2. Rule 1168 – Adhesive and Sealant Applications.

H. UL Environment:
1. GREENGUARD Gold certification program.

1.4 DEFINITIONS

A. VOC: Volatile Organic Compounds.

B. Gloss Levels: As follows, according to ASTM D 523:
1. Flat: Gloss Level 1 (not more than 5 units at 60 degrees and 10 units at 85 degrees).
2. Low-Sheen: Gloss Level 3 (10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees).
3. Semi-Gloss: Gloss Level 5 (35 to 70 units at 60 degrees).
4. Gloss: Gloss Level 6 (70 to 85 units at 60 degrees), unless indicated otherwise.

1.5 COORDINATION

A. Review other Sections of these Specifications in which prime paints are to be provided. Where requested by those trades performing Work in other Sections, provide information regarding paint products specified in this Section to ensure compatibility of overall painting system.
1. Surface preparation, priming, and coats of paint specified in this Section are in addition to surface preparation and shop priming specified in other Sections of these Specifications.
2. Where prime paints specified in other Sections of these Specifications are incompatible with prime or topcoats specified in this Section, provide barrier coats, or remove and reprime as required.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Indicate preparation requirements and application instructions.
1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product indicated, submit manufacturer’s fan deck with full range of colors for selection by Architect.

C. Samples for Verification: For each type of paint system and each color and sheen of topcoat indicated.
1. Submit Samples on rigid backing, 8 inches by 12 inches.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

E. CALGreen Submittals:

1. Manufacturer's product data for paints and coatings indicating compliance with product requirements specified in "CALGreen Requirements" Article.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from the same product run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quantity: Furnish an additional ***[5]*** percent, but not less than 1 gallon of each material and color applied.

1.8 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq ft.

b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F or as otherwise recommended in paint manufacturer's written instructions.

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.10 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F or as otherwise stated in paint manufacturer's written instructions.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by manufacturers as indicated in Paint Systems Schedules at end of this Section.

1. Material Quality: Provide manufacturer's best quality (e.g. "Premium" quality) paint products for each paint system indicated.

2. Source Limitations: Unless indicated otherwise, provide primer and topcoat products as manufactured by a single manufacturer for each paint system as specified for a given substrate and sheen.

2.2 CALGREEN REQUIREMENTS

A. General: Conform with all applicable requirements of the California Green Building Standards Code (CALGreen).

B. Paints and Coatings: Provide paints and coatings that comply with VOC limits in Table 1 of the California Air Resources Board (ARB) Architectural Coatings Suggested Control Measure for Architectural Coatings, unless more stringent local limits apply.

2.3 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As indicated at end of this Section.

2.4 ACCESSORY MATERIALS

A. Elastomeric Sealant: Single-component, non-sag, paintable joint sealant complying with ASTM C 920 Type S, Grade NS, Class 12.5.

2.5 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and Concrete Masonry Units): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Gypsum Plaster: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Gypsum Board Substrates: Verify that finishing compound is dry and sanded smooth.

E. Gypsum Plaster Substrates: Verify that plaster is fully cured.

F. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

G. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

H. Proceed with coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes acceptance of surfaces and conditions.

3.2 PREPARATION - GENERAL

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

1. For renovation products, comply with recommendations in "MPI Maintenance Repainting Manual."

B. Remove hardware, covers, plates, machined surfaces, and similar items already in place that are removable and not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces and mortar joints to be painted exceeds that permitted in manufacturer's written instructions.

F. Cement Plaster Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

G. Unprimed Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer, but not less than the following:

1. SSPC-SP 3.

H. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as is used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

I. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

J. Aluminum Substrates: Remove loose surface oxidation.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 PREPARATION - EXISTING PAINTED SURFACES

A. Interior:

1. General: Mechanically clean surfaces to remove dirt, contaminants, rust scale, and loose and peeling paint or other coatings.
    a. Dull glossy surfaces by sanding or chemical means for maximum adhesion.
    b. Remove mildew with a solution of one part household bleach to three parts water, as required to leave an uncontaminated, clean surface. Where necessary, increase strength of solution and scrub with a soft bristle brush.

3.4 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended in writing by paint manufacturer.
    a. In addition to paint manufacturer's recommendations, at high-impact gypsum board substrates, apply primer coat to a minimum dry film thickness of 1.8 mils.

3. Paint surfaces behind movable items, including equipment and furniture, same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
4. Paint doors on tops, bottoms, side edges, and cutouts same as faces of door, unless otherwise indicated.
5. Paint entire exposed surface of hollow-metal door and window frames.
6. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
7. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
8. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where if feels firm, does not deform or feel sticky under moderate thumb pressure, and application of a subsequent coat does not cause lifting or loss of adhesion of the undercoat.
9. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to ensure a topcoat with no burn-through or other defects due to insufficient sealing.

B. Paint all exposed surfaces, regardless of whether designated in Color Schedule. The term “exposed surface” includes area visible when permanent or built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas as required to maintain visual continuity and protection.
1. Interior Prefinished Items: Do not paint prefinished interior items, including the following:
    a. Finish hardware.
    b. Plastic laminate-faced wood casework and other surfaces.
    c. Ceramic tile.
    d. Operable panel partitions and accordion folding partitions.
    e. Mechanical and electrical equipment with factory-applied finish.
    f. Light fixtures.
2. Wood Surfaces with Transparent Finish: Do not paint surfaces of wood indicated to receive transparent finish.
3. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas not exposed to view.
4. Operating Parts: Do not paint moving parts of operating units, mechanical and electrical parts, such as valves, dampers, linkages, sensing devices, and motor and fan shafts.
5. Labels: Do not paint over labels, such as those indicating fire-ratings, or equipment identification, performance rating, or nomenclature plates.

C. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Give special attention to ensure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

F. Painting Roof Accessories: Paint penetrations and other items on roofs which are exposed to view. Unless noted otherwise, paint color is to match that of surrounding roofing material. Roof items to receive paint include, but are not limited to the following:

1. Plumbing vent stacks.
2. Exhaust caps.
3. Roof hatches.
4. Flues.

G. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Paint items exposed in occupied spaces including, but not limited to, the following:

1. Mechanical Work:
    a. Exposed metal ductwork and supports, unless noted otherwise.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Tanks that do not have factory-applied final finishes.
    f. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
        i) Paint with a flat black, non-specular paint.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Wall and ceiling access panels.
        i) Paint to match surrounding wall or ceiling surface, unless noted otherwise.
    i. Air inlets and outlets.
        i) Paint to match surrounding wall or ceiling surface, unless noted otherwise.
    j. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
2. Electrical, Communication, and Electronic Safety and Security Work:
    a. Switchgear without factory-applied final finish.
    b. Panelboards.
    c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
    d. Exposed conduits.
    e. Enclosures and boxes.

3.5 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINT SYSTEMS SCHEDULE – UNPAINTED SUBSTRATES

A. General: Subject to compliance with requirements, for each of the following interior unpainted substrate types and sheens, provide one of the listed paint systems or equal products in accordance with Division 1 requirements for product substitutions.

B. Regular Gypsum Board - Flat Sheen:
1. Dunn-Edwards Paints:
   a. First Coat: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
   b. Second Coat: SPMA10-1 SUPREMA Interior Flat Paint
   c. Third Coat: SPMA10-1 SUPREMA Interior Flat Paint
2. Kelly-Moore Paints:
   a. First Coat: 971 AcryPlex Interior PVA Primer/Sealer
   b. Second Coat: 550 AcryPlex Latex Interior Flat Wall Paint
   c. Third Coat: 550 AcryPlex Latex Interior Flat Wall Paint
3. Sherwin-Williams Company:
   a. First Coat: B28W02600 ProMar 200 Zero VOC Interior Latex Primer
   b. Second Coat: B30-2600 Series ProMar 200 Zero VOC Interior Latex Flat
   c. Third Coat: B30-2600 Series ProMar 200 Zero VOC Interior Latex Flat

C. Regular Gypsum Board - Eggshell (Satin) Sheen:
1. Dunn-Edwards Paints:
   a. First Coat: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
   b. Second Coat: SPMA40 SUPREMA Interior Low Sheen Paint
   c. Third Coat: SPMA40 SUPREMA Interior Low Sheen Paint
2. Kelly-Moore Paints:

a. First Coat: 971 AcryPlex Interior PVA Primer/Sealer
b. Second Coat: 1610 AcryPlex Interior Eggshell Enamel
c. Third Coat: 1610 AcryPlex Interior Eggshell Enamel

3. Sherwin-Williams Company:
a. First Coat: B28W02600 ProMar 200 Zero VOC Interior Latex Primer
b. Second Coat: B20-2600 Series ProMar 200 Zero VOC Interior Latex Eg-Shel
c. Third Coat: B20-2600 Series ProMar 200 Zero VOC Interior Latex Eg-Shel

D. Regular Gypsum Board - Semi-Gloss Sheen:
1. Dunn-Edwards Paints:
a. First Coat: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
b. Second Coat: SPMA50 SUPREMA Interior Semi-Gloss Paint
c. Third Coat: SPMA50 SUPREMA Interior Semi-Gloss Paint

2. Kelly-Moore Paints:
a. First Coat: 971 AcryPlex Interior PVA Primer/Sealer
b. Second Coat: 1650 AcryPlex Interior Semi-Gloss Enamel
c. Third Coat: 1650 AcryPlex Interior Semi-Gloss Enamel

3. Sherwin-Williams Company:
a. First Coat: B28W02600 ProMar 200 Zero VOC Interior Latex Primer
b. Second Coat: B31-2600 Series ProMar 200 Zero VOC Interior Latex Semi-Gloss
c. Third Coat: B31-2600 Series ProMar 200 Zero VOC Interior Latex Semi-Gloss

E. Hollow-Metal Steel Doors and Frames (Shop-Primed), and Steel Railings - Semi-Gloss Sheen:
1. Dunn-Edwards Paints:
a. First Coat: ULDM00-0-GR ULTRASHIELD Interior/Exterior DTM Gray Primer
b. Second Coat: ULDM50 ULTRASHIELD Interior/Exterior DTM Semi-Gloss Paint
c. Third Coat: ULDM50 ULTRASHIELD Interior/Exterior DTM Semi-Gloss Paint

2. Kelly-Moore Paints:
a. First Coat: 5725 DTM Acrylic Primer/Finish
b. Second Coat: 5885 DTM Acrylic Semi-Gloss Enamel
c. Third Coat: 5885 DTM Acrylic Semi-Gloss Enamel

3. Sherwin-Williams Company:
a. First Coat: B66W00310 Pro Industrial Pro-Cryl Universal Primer
b. Second Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss
c. Third Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss

F. Shop-Primed and Unprimed Steel (Other Than Hollow-Metal Steel Doors and Frames, and Steel Railings) - Semi-Gloss Sheen:
1. Dunn-Edwards Paints:
a. First Coat: BRPR00-2-WH BLOC-RUST Premium Interior/Exterior Rust Preventative Metal Primer

b. Second Coat: EVSH50-2 EVERSHIELD Exterior/Interior Semi-Gloss Paint
c. Third Coat: EVSH50-2 EVERSHIELD Exterior/Interior Semi-Gloss Paint

2. Kelly-Moore Paints:
a. First Coat: 5725 DTM Acrylic Primer/Finish
b. Second Coat: 1650 AcryPlex Interior Semi-Gloss Enamel
c. Third Coat: 1650 AcryPlex Interior Semi-Gloss Enamel

3. Sherwin-Williams Company:
a. First Coat: B66W00310 Pro Industrial Pro-Cryl Universal Primer
b. Second Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss
c. Third Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss

G. Shop-Primed and Unprimed Steel (Other Than Hollow-Metal Steel Doors and Frames) - Gloss Sheen:

1. Dunn-Edwards Paints:
a. First Coat: BRPR00-2-WH BLOC-RUST Premium Interior/Exterior Rust Preventative Metal Primer
b. Second Coat: EVSH60-2 EVERSHIELD Exterior/Interior Gloss Paint
c. Third Coat: EVSH60-2 EVERSHIELD Exterior/Interior Gloss Paint

2. Kelly-Moore Paints:
a. First Coat: 5725 DTM Acrylic Primer/Finish
b. Second Coat: 1680 DuraPoxy Acrylic Interior Gloss Enamel
c. Third Coat: 1680 Dura-Poxy Acrylic Interior Gloss Enamel

3. Sherwin-Williams Company:
a. First Coat: B66W00310 Pro Industrial Pro-Cryl Universal Primer
b. Second Coat: B66-600 Series Pro Industrial Acrylic Gloss
c. Third Coat: B66-600 Series Pro Industrial Acrylic Gloss

3.8 INTERIOR PAINT SYSTEMS SCHEDULE - EXISTING PAINTED SUBSTRATES

A. General: Paint systems listed below are intended for application over interior substrates with existing paint coatings. Subject to compliance with requirements, for each of the following substrate types and sheens, provide one of the listed paint systems or equal products in accordance with Division 1 requirements for product substitutions.

1. Where spot priming is indicated, only those unpainted areas in which bare substrate is exposed are required to be primed.

B. Existing Painted Regular Gypsum Board - Flat Sheen:

1. Dunn-Edwards Paints:
a. Spot Prime: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
b. First Coat: SPMA10-1 SUPREMA Interior Flat Paint
c. Second Coat: SPMA10-1 SUPREMA Interior Flat Paint

2. Kelly-Moore Paints:
a. Spot Prime: 971 AcryPlex Interior PVA Primer/Sealer

b. First Coat: 550 AcryPlex Latex Interior Flat Wall Paint
c. Second Coat: 550 AcryPlex Latex Interior Flat Wall Paint

3. Sherwin-Williams Company:
a. Spot Prime: B28W02600 ProMar 200 Zero VOC Interior Latex Primer
b. First Coat: B30-2600 Series ProMar 200 Zero VOC Interior Latex Flat
c. Second Coat: B30-2600 Series ProMar 200 Zero VOC Interior Latex Flat

C. Existing Painted Regular Gypsum Board - Eggshell (Satin) Sheen:
1. Dunn-Edwards Paints:
a. Spot Prime: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
b. First Coat: SPMA40 SUPREMA Interior Low Sheen Paint
c. Second Coat: SPMA40 SUPREMA Interior Low Sheen Paint

2. Kelly-Moore Paints:
a. Spot Prime: 971 AcryPlex Interior PVA Primer/Sealer
b. First Coat: 1610 AcryPlex Interior Eggshell Enamel
c. Second Coat: 1610 AcryPlex Interior Eggshell Enamel

3. Sherwin-Williams Company:
a. Spot Prime: B28W02600 ProMar 200 Zero VOC Interior Latex Primer
b. First Coat: B20-2600 Series ProMar 200 Zero VOC Interior Latex Eg-Shel
c. Second Coat: B20-2600 Series ProMar 200 Zero VOC Interior Latex Eg-Shel

D. Existing Painted Regular Gypsum Board - Semi-Gloss Sheen:
1. Dunn-Edwards Paints:
a. Spot Prime: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
b. First Coat: SPMA50 SUPREMA Interior Semi-Gloss Paint
c. Second Coat: SPMA50 SUPREMA Interior Semi-Gloss Paint

2. Kelly-Moore Paints:
a. Spot Prime: 971 AcryPlex Interior PVA Primer/Sealer
b. First Coat: 1650 AcryPlex Interior Semi-Gloss Enamel
c. Second Coat: 1650 AcryPlex Interior Semi-Gloss Enamel

3. Sherwin-Williams Company:
a. Spot Prime: B28W02600 ProMar 200 Zero VOC Interior Latex Primer
b. First Coat: B31-2600 Series ProMar 200 Zero VOC Interior Latex Semi-Gloss
c. Second Coat: B31-2600 Series ProMar 200 Zero VOC Interior Latex Semi-Gloss

E. Existing Painted Impact-Resistant Gypsum Board - Flat Sheen:
1. Dunn-Edwards Paints:
a. Spot Prime: VNPR00-1 VINYLASTIC Premium Interior Wall Sealer
i) Minimum Solids Content by Volume: 40%
b. First Coat: SPMA10-1 SUPREMA Interior Flat Paint
c. Second Coat: SPMA10-1 SUPREMA Interior Flat Paint

2. Kelly-Moore Paints:
    a. Spot Prime: 123-102 KEL-PRO Latex Heavy Bodied Wall Primer
        i) Minimum Solids Content by Volume: 40%
    b. First Coat: 550 AcryPlex Latex Interior Flat Wall Paint
    c. Second Coat: 550 AcryPlex Latex Interior Flat Wall Paint
3. Sherwin-Williams Company:
    a. Spot Prime: A63W00100 Builders Solution Interior Latex Primer/Surfacer
        i) Minimum Solids Content by Volume: 40%
    b. First Coat: B30-2600 Series ProMar 200 Zero VOC Interior Latex Flat
    c. Second Coat: B30-2600 Series ProMar 200 Zero VOC Interior Latex Flat

F. Existing Painted Hollow-Metal Steel Doors and Frames, and Steel Railings - Semi-Gloss Sheen:
1. Dunn-Edwards Paints:
    a. Spot Prime: ULDM00-0-GR ULTRASHIELD Interior/Exterior DTM Gray Primer
    b. First Coat: ULDM50 ULTRASHIELD Interior/Exterior DTM Semi-Gloss Paint
    c. Second Coat: ULDM50 ULTRASHIELD Interior/Exterior DTM Semi-Gloss Paint
2. Kelly-Moore Paints:
    a. Spot Prime: 5725 DTM Acrylic Primer/Finish
    b. Second Coat: 5885 DTM Acrylic Semi-Gloss Enamel
    c. Third Coat: 5885 DTM Acrylic Semi-Gloss Enamel
3. Sherwin-Williams Company:
    a. Spot Prime: B66W00310 Pro Industrial Pro-Cryl Universal Primer
    b. First Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss
    c. Second Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss

G. Existing Painted Steel (Other Than Hollow-Metal Steel Doors and Frames and Steel Railings) - Semi-Gloss Sheen:
1. Dunn-Edwards Paints:
    a. Spot Prime: UGPR00-1 ULTRA-GRIP Premium Interior/Exterior Multi-Surface Primer
    b. First Coat: EVSH50-2 EVERSHIELD Exterior/Interior Semi-Gloss Paint
    c. Second Coat: EVSH50-2 EVERSHIELD Exterior/Interior Semi-Gloss Paint
2. Kelly-Moore Paints:
    a. Spot Prime 5725 DTM Acrylic Primer/Finish
    b. First Coat: 1650 AcryPlex Interior Semi-Gloss Enamel
    c. Second Coat: 1650 AcryPlex Interior Semi-Gloss Enamel
3. Sherwin-Williams Company:
    a. Spot Prime: B66W00310 Pro Industrial Pro-Cryl Universal Primer
    b. First Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss
    c. Second Coat: B66-650 Series Pro Industrial Acrylic Semi-Gloss

H. Existing Painted Steel (Other Than Hollow-Metal Steel Doors and Frames) - Gloss Sheen:

1. Dunn-Edwards Paints:
    a. Spot Prime: UGPR00-1 ULTRA-GRIP Premium Interior/Exterior Multi-Surface Primer
    b. First Coat: EVSH60-2 EVERSHIELD Exterior/Interior Gloss Paint
    c. Second Coat: EVSH60-2 EVERSHIELD Exterior/Interior Gloss Paint
    d. Second Coat: 143 Mirro Glide Interior/Exterior 100% Acrylic Gloss Enamel
2. Kelly-Moore Paints:
    a. Spot Prime: 5725 DTM Acrylic Primer/Finish
    b. First Coat: 1680 DuraPoxy Interior Gloss Enamel
    c. Second Coat: 1680 DuraPoxy Interior Gloss Enamel
3. Sherwin-Williams Company:
    a. Spot Prime: B66W00310 Pro Industrial Pro-Cryl Universal Primer
    b. First Coat: B66-600 Series Pro Industrial Acrylic Gloss
    c. Second Coat: B66-600 Series Pro Industrial Acrylic Gloss

3.9 PAINT COLOR/SHEEN SCHEDULE

A. Paint Colors: As specified in Section 09 06 00 “Colors and Finishes.”

END OF SECTION 09 91 00

SECTION 10 2310

GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Frameless glazed interior wall and door assemblies.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

E. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer, other entities directly affecting, or affected by, construction activities of this section.
   2. Notify Architect four calendar days in advance of scheduled meeting date.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each component in partition assembly.

C. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
   1. Include field measurements of openings.
   2. Include Elevations Showing:
      a. Locations and identification of manufacturer-supplied door hardware and fittings.
      b. Locations and sizes of cut-outs and drilled holes for other door hardware.
   3. Include Details Showing:
      a. Requirements for support and bracing of overhead track.
      b. Installation details.
      c. Appearance of manufacturer-supplied door hardware and fittings.

D. Selection Samples: Two sets, representing manufacturer's full range of available metal materials and finishes.

E. Verification Samples: Two samples, minimum size 2 by 3 inches (50 by 75 mm), representing actual material and finish of exposed metal.

F. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

G. Certificates: Contractor to certify that installer of partition assemblies meets specified qualifications.

H. Operation and Maintenance Data: For manufacturer-supplied operating hardware.

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

J. Specimen Warranty.

K. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum three years of experience designing, assembling, and installing partition assemblies similar to those specified in this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

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

C. Provide five year manufacturer warranty against excessive degradation of metal finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Frameless Glazed Interior Wall and Door Assemblies:
   1. C.R. Laurence Co., Inc; CRL Clear View Series Frameless Glass Wall Office System: www.crl-arch.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMELESS GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

A. Frameless Glazed Interior Wall Assembly: Factory fabricated assemblies consisting of full-width and height glass panels fastened with low profile sidelite aluminum rail fittings on top and bottom edge of glass wall.
   1. Configuration: As indicated on drawings.
   2. Full Length Top and Bottom Sidelite Rails: 2-5/16 inch (59 mm) high by 1-1/2 inch (38 mm) deep with end caps.
   3. Sidelite Fittings, Clad Finish: Satin anodized.
   4. Glass Thickness: 1/2 inch (12.7 mm), tempered.
   5. Designed to withstand normal operation without damage, racking, sagging, or deflection.
   6. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
   7. Finished metal surfaces protected with strippable film.
   8. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.

B.. Pivoting Glass Doors: Full length dry glazed rail fittings.
1. Door Configuration: As indicated on drawings.
2. Full Length Top and Bottom Rails: 2-5/16 inch (59 mm) high by 1-1/2 inch (38 mm) deep with end caps.
3. Glass Thickness: 1/2 inch (12.7 mm), tempered.
4. Sidelite Rails: Match door rail sightlines and finish.
5. Aluminum Finish: Satin anodized.
6. Door Hardware: Locking ladder pulls, brushed stainless steel.
7. Provide accessories as required for complete installation.
8. Basis of Design: C.R. Laurence Co., Inc; CRL Wedge-Lock Low Profile Door Rail System: www.crl-arch.com.

2.03 FITTINGS AND HARDWARE

A. Operable Panel Hardware: Coordinate with additional requirements as specified in Section 08 7100.

2.04 MATERIALS

A. Glass: Flat glass meeting requirements of ASTM C1036, Type I - Transparent Flat Glass, Class 2 - Tinted, Quality Q3, fully tempered in accordance with ASTM C1048, Kind FT, and as follows:
1. Thickness: As indicated.
2. Color: Grey tint; low iron.
3. Prepare glazing panels for indicated fittings and hardware before tempering.
4. Polish edges that will be exposed in finished work to bright flat polish.
5. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.

B. Aluminum Components: Conforming to ASTM B221 (ASTM B221M), Alloy 6063, T5 Temper.

C. Sealant: One-part silicone sealant, conforming to ASTM C920, clear.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that track supports are properly braced, level within 1/4 inch (6 mm) of required position and parallel to the floor surface.

C. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

D. Do not begin installation until supports and adjacent substrates have been properly prepared.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

B. Prepare substrates using the methods recommended by the manufacturer for achieving acceptable result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with glazed interior wall and door assembly manufacturer's instructions.

B. Fit and align glazed interior wall and door assembly level and plumb.

3.04 ADJUSTING

A. Adjust glazed interior wall and door assembly to operate smoothly from sliding or pivoting positions.

B. Adjust swing door hardware for smooth operation.

3.05 CLEANING

A. Clean installed work to like-new condition.

B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.06 CLOSEOUT ACTIVITIES

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

B. Demonstrate operation of glazed interior wall and door assembly and identify potential operational problems.

3.07 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before date of Substantial Completion.

Hardware Sets

Set: 1.0

Doors: 121A

1	Patch	As Required	US32D	GS
1	Pivot	PF-ADJ-PIVOT	US32D	GS
1	Locking Pull	LP3301FHD ADA_FinSet1	US32D	GS
1	Concealed Closer	OHC-609-90NHO		GS
1	Door Stop	403/441H as required	US26D	RO

END OF SECTION

SECTION 10 51 13

WIDE SPAN SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

RaptorRAC Wide Span Shelving

B. Related Work, Not Furnished:

Finish floor covering materials and installation.

C. Related Sections:

[Sections in Division 9 – Finishes, relating to finish floor and base materials]

D. Allowances:

E. Alternates:

1.3 REFERENCES

A. American National Standards Institute (ANSI) Standards:

Applicable standards for fasteners used for assembly.

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

Applicable standards for steel sheet materials used for fabrication

Applicable standards for the testing of electrostatically applied Powder Coat Paint

C. American Institute Of Steel Construction (AISC) Standards:

Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

A. General: RaptorRAC Wide Span Shelving

B. Finishes:

Fabricated Metal Components and Assemblies: All components to be painted with an electro-statically applied Powder Coat paint that can meet or exceed test requirements set out by ASTM standard D3451-06 Standard Guide for Testing Coating Powders and Powder Coatings.

Sizes can be described in paragraph below or in a SCHEDULE attached as the last page of the section.

1.5 PERFORMANCE REQUIREMENTS

A. Design Requirements:

Refer to Drawings for sizes.

B. Seismic Performance: Provide wide span shelving capable of withstanding the effects of earthquake movement when required by applicable building codes.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of wide span shelving required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details, including descriptions of procedures and diagrams. Show complete wide span installation layout, including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.

Show installation details at non-standard conditions, if any.

Provide layout, dimensions, and identification of each unit, corresponding to sequence of installation procedures.

Provide installation schedule and procedures to ensure proper installation.

C. Samples: Provide minimum [3] inches or [76] millimeters square example of each color and texture on actual substrate for each component to remain exposed after installation.

D. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts, consisting of actual product pieces, showing full range of colors and textures available.

E. Warranty: Submit draft copy of proposed warranty for review by the [Architect] Maintenance Data: Provide written documentation of the manufacturer’s statement, claiming the maintenance free nature of the product.

F. Reference List: Provide a list of recently installed wide span shelving to be visited by owner, architect, and contractor. Intent of list is to aid in verifying the suitability of manufacturer's products and comparison with materials and product specified in this section. Include contact name, address, and phone numbers.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001:2008 certified for the design, production, installation and service of wide span shelving. Furnish certification attesting ISO 9001:2008 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is the manufacturer's authorized representative for the specified products for installing wide span shelving.

Minimum Qualifications: 1-year experience installing wide span shelving of comparable size and complexity to specified project requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of wide span shelving units before fabrication. Indicate verified measurements on shop drawings. Coordinate fabrication and delivery to ensure no delay in progress of the work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating wide span shelving units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.10 [SEQUENCING AND SCHEDULING]

A. Sequence wide span shelving [with other work] to minimize possibility of damage and soiling, during remainder of construction period.

B. Schedule installation of specified wide span shelving after finishing operations, including painting, have been completed.

C. Provide components, which must be built in at a time, which causes no delays in the general progress of the work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing wide span shelving including, but not limited to, the following:

Recommended attendees include:

1. Owner's Representative.
2. Prime Contractor or representative.
3. The [Architect] [Architect/Engineer] [Engineer/Architect] [Engineer] [Designer].
4. Manufacturer's representative.
5. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.11 WARRANTY

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Condition’s provisions of the Contract Documents.

B. Limited Lifetime Warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the wide span shelving manufactured by it will be free from defects in materials and workmanship for the lifetime of the wide span shelving.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: RaptorRAC™ Wide Span Shelving; based upon wide span shelving manufactured by Spacesaver Corporation, 1450 Janesville Avenue, Fort Atkinson, Wisconsin 53538-2798. Telephone: 800-492-3434. Or Approved Equal

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified. Use furniture grade sheet and fasteners for component fabrication unless indicated otherwise. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.

2.3 MANUFACTURED COMPONENTS

Uprights:

1. Knock-Down Upright frames shall be a bolt together design utilizing vertical post and horizontal ladder bracing. Upright posts shall be 14-gauge (1.90 mm) steel, box-formed, 2" (50.8 mm) by 1-9/16" (39.69 mm), designed with notches on the front face of post, located on 1-1/2" (38.1 mm) centers, to allow for easy adjustment of horizontal load bearing beams. Sides of post shall have notches, located on 1-1/2" (38.1 mm) centers, to accommodate anchor feet, supports, tie plates, and securing beams to post. Horizontal ladder brace component shall be 12-gauge (2.66 mm) steel with two integral lances and one 5/16" (7.94 mm) hole on each end to engage and secure to vertical post.

Beams:

1. Heavy Duty Beams shall be 12-gauge (2.66 mm) steel with "Z"- shaped structural design. Overall height of beam shall be 4-5/8" (117.48 mm) nominal. Each beam shall have slots punched along it, length to accommodate front to back shelf supports; length and location of supports are dependent on shelving load requirements. Beam mounting end brackets shall be manufactured from 12-gauge (2.66 mm) material and welded to each end of the beam. All welded upright beam construction shall meet AWS D1.3 certified welding standards.

Decking:

1. Flat Wire Decking shall be steel 5-gauge (4.62 mm) wire fabricated on a flat 2" (50.8mm) by 4" (104.6 mm) rectangular grid pattern. Flat wire decking shall be available in widths of 24" (609.6 mm) and 36" (914.44 mm). Flat wire decking shall be also available in depths of 24" (609.6 mm), 36" (914.4 mm), and 48" (1,219.2 mm).

Accessories:

1. Tire Beams shall be 12-gauge (2.66 mm) steel. Overall height of beam shall be 4" (101.6 mm). Each beam shall have slots punched along its length to accommodate front to back tire beam supports. One tire beam support is required per pair of beams. Beam mounting end brackets shall be manufactured from 12-gauge (2.66 mm) material and welded to each end of the beam. All welded upright beam construction shall meet AWS D1.3 certified welding standards.
2. Hanger Bar shall be available in two options: 1 5/16" (33.3 mm) outside diameter hanger bar constructed of 11-gauge (3.05 mm) steel and 1 ¾" (44.45 mm) outside diameter hanger bar constructed of 16-gauge (1.65 mm) steel. Hanger bar brackets shall be manufactured of 12-gauge (2.66 mm) steel and allow for center placement of the hanger bar. Overall height of hanger bar brackets shall be 4 ¾" (119.38 mm).

2.4 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the work.

2.5 FINISHES

A. Colors: [Selected from manufacturer's standard available colors.] Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Society for Testing and Materials (ASTM) Standards:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine wide span shelving scheduled to receive accessories [with Installer present] for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.

B. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer’s written instructions for installation of each type of accessory item specified.

3.3 FIELD QUALITY CONTROL

A. Verify accessory unit alignment and plumb after installation. Correct if required, following manufacturer’s instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris, resulting from installation, upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end-user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 11 52 13

PROJECTION SCREENS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Front-projection screens.

B. Related Sections include the following:
   1. Division 6 Section Miscellaneous Carpentry for wood backing for recessed screen installation.
   2. Division 26 Sections for electrical service and connections including metal device boxes for switches and conduit.

1.02 DEFINITIONS

A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.03 SUBMITTALS

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

B. Shop Drawings: Show layouts and types of projection screens. Include the following:
   1. Location of screen centerline relative to ends of screen case.
   2. Location of wiring connections.
   3. Location of seams in viewing surfaces.
   4. Drop length.
   5. Connections to supporting structure for pendant- and recess-mounted screens.
   6. Anchorage details.
   7. Details of juncture of exposed surfaces with adjacent finishes.
   8. Frame details.
   9. Accessories.
   10. Wiring Diagrams: For electrically operated units.

C. Samples for Initial Selection: For finishes of surface-mounted screen cases.

D. Maintenance Data: For projection screens to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of projection screen through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Measurement of Gain of Screen Viewing Surface: Measure gain of screen viewing surface against that of a magnesium carbonate surface by means of a photogoniometer using test methods and test apparatus per FS GG-S-00172D(1) for determining effect of reflected light at various viewing angles on screen surfaces. Ratings of "one" refer to those viewing surfaces having a reflectivity equal to the magnesium carbonate surface.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Fire Performance Characteristics: Provide projection screen fabric identical to those materials that have undergone testing and passed requirements for flame resistance as indicated below:

1. NFPA 701 per small-scale test.
2. Federal Standard 191A/5903 for test method. FS GG-S-00172D(1) for flame resistance.

E. Mildew Resistance: Provide mildew resistant screen fabrics as determined by Federal Standard 191A/5760.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

B. Protect screens from damage during delivery, handling, storage and installation.

C. Store projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.06 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.01 FRONT PROJECTION SCREENS, ELECTRICALLY OPERATED:

A. General: Provide manufacturer's standard UL-listed and-marked units consisting of case, screen, motor, controls, mounting accessories and other components as required for a complete installation and complying with requirements indicated for screen surface, controls, case, motor and screen as described.

B. Screen Fabric: The screen fabric will have a black base fabric upon which the viewing surface is applied.

C. Viewing Surface of Screen: Comply with the following requirements for the viewing surface:

1. Screen Gain: Provide a matte white viewing surface with a screen gain as specified.
2. Edge Treatment: Black masking borders. Minimum size of masking: 3” on sides and bottom of screen,
3. Top Masking: Provide minimum 12” of black masking at the top of the screen or as noted on the Category AV drawings to locate the image area to the correct level. Screen shall incorporate a tab tensioning system to prevent an uneven screen surface.
4. Size of Viewing Surface: Refer to the Category AV drawings for screen sizes and locations.

D. Electrically Operated Screens, General:

1. Screen Case: Wood or metal sides and top, with metal-lined motor compartment, factory-primed.
2. Case Color: Black.
3. Motor: Instant reversing, gear drive motor of size and capacity recommended by screen manufacturer, with permanently lubricated ball bearings, automatic thermal overload protection, preset limit switches to automatically stop screen in "up" and "down" position, and positive stop action to prevent coasting; mounted in motor compartment in the following location and remotely controlled as indicated.
4. Mount motor on left end of screen, unless otherwise indicated.
5. Screen: Mildew- and flame-resistant seamless glass fiber fabric with vinyl-coated viewing surface complying with requirements indicated, with top edge mounted on, and securely anchored to, rigid metal roller supported by self-aligning bearings in brackets. Screen shall include integral tab tensioning system.
6. Screen Controls: The control operation of each screen is as follows:
    a. Single-Station Control: The control of the projection screen shall be accomplished in agreement with the manufacturer recommended practice. Provide a low voltage control system for each screen consisting of a single control unit containing transformer for reducing 120 VAC electric power supply to 24 volts, pulse sequence relays and terminal block.
        1) Control Switch: Provide a single three button control switch with a faceplate for each projection screen. The control switch shall be housed in a metal backbox installed in the wall so that the face-plate is mounted flush to the wall. Provide conduit and wiring between the device box and the projection screen motor housing as shown on the Category AV drawings. Provide cover plates for flush wall mounting. The finish of the cover plate shall be white. Locate the control panel at switch height. Coordinate the location of the control panels with the Architect.
        2) Interface to Remote Control System: Provide dry contact closures from the remote control system (refer to Section 274100 for additional information) to control the screen.

E. Wall Mount, Metal Encased, Electrically Operated Screen: Motor-in-roller units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed steel sheet not less than 0.027 inch thick or aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide units with end caps and universal mounting brackets, finished to match end caps. Coordinate mounting detail with Architect.

1. Product: Da-Lite Tensioned Cosmopolitan Electrol or equal.

F. Screen material and Viewing surface:

1. Backing: Screen material mounted to black backing material
2. Matte-White Viewing Surface: Peak gain of 1.0, and half-gain angle of not less than 60 degrees.
3. Acceptable Products: Da-Lite Da-Matt or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Install low-voltage controls according to NFPA 70 and manufacturer's written instructions.
2. Wiring Method: Install wiring in raceway.
3. Test electrically operated units to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.
4. Test manually operated units to verify that screen operating components are in optimum functioning condition.

3.02 WORKMANSHIP

A. The finished installation shall be free from damage, flaws, blemishes or other defects detrimental to appearance.

B. Provide protection as required to ensure satisfactory operation and appearance at completion of project.

3.03 PROTECTING AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11 52 13

SECTION 12 22 13

DRAPES AND TRACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Drapes.
   2. Drapery tracks.

B. Related Sections include:
   1. Section 09 22 16 “Cold-Formed Non-Structural Metal Framing” for concealed metal backing in structural metal stud-framed walls for mounting drapery tracks.
   2. Section 12 24 13 “Roller Shades” for roller shades.

1.3 REFERENCES

A. ASTM International:

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Drapery Tracks: Include maximum weights of draperies that can be supported.
   2. Fabrics and textile treatments.

B. Shop Drawings:
   1. Tracks: Show installation and anchorage details and locations of controls.
   2. Drapes: Show sizes, locations, and details of installation.

C. Samples for Initial Selection: For each type of product indicated involving color and pattern selection, submit manufacturer’s full range for selection by Architect.
   1. Minimum Number of Drapery Fabric Colors for Selection: ***[9]***.

D. Samples for Verification: As follows:
   1. Tracks: 18 inches long, with carriers, controls, and accessories.
   2. Drapery Fabrics: For each color and pattern indicated, full width by 36 inches long, from dye lot to be used for the Work and with specified textile treatments applied. Show complete pattern repeat if any. Mark top and face of fabric.

3. Drapery Fabrication Samples: For each heading, fabric, color, and pattern indicated, a complete full-size panel to verify details of fabrication and thread colors.
4. Drapery Lining Samples

E. Product Schedule: Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For drapery track installation; reflected ceiling plans drawn to scale and coordinating track installation with openings and ceiling-mounted items, on which the following items are shown:
1. Suspended ceiling components.

B. Product Certificates: For each drapery fabric treated with flame retardant, signed by fabric supplier and indicating treatment durability and cleaning procedures required to maintain treatment effectiveness.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For products to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match materials installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Drapery Track and Carriers: For each size indicated, equal to ***[5]*** percent of amount installed, but no fewer than ***[10]*** of each size.
2. Drapery Fabrics: For each fabric, color, and pattern indicated, from the same product run, full-width lengths equal to ***[5]*** percent of amount installed, but no fewer than ***[10]*** yards of each fabric, color, and pattern.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: For draperies and tracks, fabricator of draperies.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockup at location and in size as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before drape fabrication and indicate measurements on Shop Drawings.

B. Scheduling: Do not deliver or install drapes until after other finish work, including painting, is complete and spaces are otherwise ready for occupancy.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Provide drapery fabric products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Comply with applicable requirements of the California Code of Regulations, Title 19 – Public Safety, for fire-retardant fabrics.

2.2 DRAPERY TRACKS

A. Motorized Track: Manufacturer's track designed for heavy-duty applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. SM Automatic; Model 140-s
   b. Vertilux; 6-700-DM Series
   c. Silent Gliss USA Inc.; SG5600 Series
   d. Equal product in accordance with Division 1 requirements for product substitutions
2. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches on center.
   a. Lengths and Configurations: As indicated on Drawings.
   b. Support Capability: Weight of drape indicated mounted on track length as indicated.
   c. Finish: White baked enamel.
3. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.
   a. Mounting Surface: Ceiling.
4. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
5. Operation: Motor.
   a. Motor Location: Wall, unless indicated otherwise.
   b. Draw: One way, stack as indicated on Drawings.
   c. Operating Hardware Location: On stack side, unless indicated otherwise.

6. Carriers: Ball-bearing rollers with hooks.
7. Master Carriers: Overlap

B. Manual Track: Manufacturer's track designed for heavy-duty applications.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Vertilux; manually-operated with draw baton
b. Silent Gliss USA Inc.; SG6970 Series
c. Equal product in accordance with Division 1 requirements for product substitutions
2. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches on center.
a. Lengths and Configurations: As indicated on Drawings.
b. Support Capability: Weight of drape indicated mounted on track length as indicated.
c. Finish: White baked enamel.
3. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.
a. Mounting Surface: Ceiling.
4. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
5. Operation: Draw baton
a. Draw: One way, stack left.
6. Carriers: Ball-bearing rollers with hooks
a. Master Carriers: Overlap.

2.3 DRAPES

A. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.

B. Wall Drape:
1. Heading:
a. Ripple fold: 50 percent fullness.
b. Heading Accessories:
i) Nonwoven buckram.
ii) Hooks.
2. Drapery Fabric:

a. Manufacturer: Designtex.
b. Color: As specified in Section 09 06 00 “Colors and Finishes.”
c. Fiber Content: 100% flame-retardant polyester.
d. Weight: 6.22 oz per linear yard.

Width: 48 inches.

3. Lining Fabric:
   a. Lining Type: fire rated, sound absorbing
      i) Quiet Curtains; Nova Suede (David Tivadar (858) 518-1264)
      ii) Equal product in accordance with Division 1 requirements for product substitutions
   b. Color: White.
   c. Fiber Content: 100% polyester.
   d. Textile Treatments: Stain repellent; and flame retardant, polymer type.
   e. Weight: 13 oz. per linear yard
   f. Width: 54 inches

C. Room Divider Drape:
   1. Heading:
      a. Ripple fold: 5 percent fullness.
      b. Heading Accessories:
         i) Nonwoven buckram.
         ii) Hooks.
   2. Drapery Fabric:
      a. Manufacturer: Designtex.
      b. Color: As specified in Section 09 06 00 “Colors and Finishes.”
      c. Fiber Content: 100% flame-retardant polyester.
      d. Weight: 6.22 oz per linear yard.
      e. Width: 48 inches.
   3. Lining Fabric:
      a. Lining Type: fire rated, sound blocking
         i) Quiet Curtains; STC 17 (David Tivadar (858) 518-1264)
         ii) Equal product in accordance with Division 1 requirements for product substitutions
      b. Color: White.
      c. Fiber Content: 100% polyester.
      d. Textile Treatments: Stain repellent; and flame retardant, polymer type.
      e. Weight: 48 oz. per linear yard

f. Width: 54 inches

D. Hem Weights: 1-inch square lead weights.

2.4 DRAPE FABRICATION

A. Fabricate drapes in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.

1. One-Way-Stacking Drapes: Add five inches to overall width for returns.
2. Center-Opening Drapes: Add 10 inches to overall width for overlap.

B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.

C. Side Hems: Double-turned, 1-1/2-inch wide hems consisting of three layers of fabric, and blindstitched so that stitches are not visible on face of drape.

D. Bottom Hems: Double-turned, four-inch-wide hems on the face and back fabric, bottom with three-layer construction intentionally left open for better stacking.

E. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch return of face fabric.

PART 3 - EXECUTION

3.1 DRAPERY TRACK INSTALLATION

A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

3.2 DRAPERY INSTALLATION

A. Where drapes abut overhead construction, hang drapes so that clearance between headings and overhead construction is 1/4 inch.

B. Where drapes extend to floor, install so that bottom hems clear finished floor by not more than 1 inch and not less than 1/2 inch.

C. Where drapes extend to windowsill, install so that bottom hems hang above sill line and clear sill line by not more than 1/2 inch.

3.3 ADJUSTING

A. After hanging drapes, test and adjust each track to produce unencumbered, smooth operation.

B. Steam and dress down drapes as required to produce crease- and wrinkle-free installation.

C. Remove and replace drapes that are stained or soiled.

END OF SECTION 12 22 13

SECTION 12 24 13

ROLLER SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Manually-operated roller shades with single rollers for windows.

B. Related Sections include:

1. Section 09 22 16 “Cold-Formed Non-Structural Metal Framing” for concealed metal stud framing and backing in nonstructural metal stud-framed walls and soffits for mounting roller shades and accessories.

1.3 REFERENCES

A. California Department of Public Health (CDPH):

1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – Version 1.1, February 2010.

B. National Electrical Manufacturer’s Association (NEMA):

1. NEMA ICS 6: Industrial Control and Systems Enclosures.

C. National Fire Protection Association (NFPA):

1. NFPA 70: National Electrical Code.
2. NFPA 701: Fire Tests for Flame-Resistant Textiles and Films.

D. Window Covering Safety Council (formerly Window Covering Manufacturer’s Association, WCMA):

1. WCMA A100.1: Safety of Corded Window Covering Products (ANSI).

1.4 COORDINATION

A. Coordinate sizes and locations of concealed framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that roller shades can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
2. Motors: Show nameplate data, ratings, characteristics, electrical power requirements, and mounting arrangements.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Verification:
1. For each color and pattern of the following:
a. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
b. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
c. Exposed metal finishes, 4 inches by 4 inches on same metal used for fabrication of unit.

D. Roller Shade Schedule: Use same designations indicated on Drawings, and include opening sizes.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From manufacturer, for each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals. Include the following.
1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.
4. Motorized shade operator.

1.8 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and pattern of shadeband material indicated, but no fewer than two units.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Firm experienced in installing roller shades, with a 5 year minimum record of successful in-service performance, and employing workers trained and approved by manufacturer.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace roller shade units that fail in materials or workmanship within specified warranty period.

1. Roller Shade Hardware, Chain, and Shade Band Material:
   a. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades through one source from a single manufacturer.

2.2 MANUALLY-OPERATED SINGLE-ROLLER SHADES

A. General: Manufacturer's complete system for manually operated single-roller window shades, including operator, operating hardware, and accessories.

1. Subject to compliance with requirements, provide one of the following:

a. MechoSystems, Inc.; Mecho/5.

b. Equal product in accordance with Division 1 requirements for product substitutions.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead-chain and clutch that stops shade movement when bead-chain is released; permanently adjusted and lubricated.

1. Bead-Chains: Stainless-steel.

a. Loop Length: Length required to make operation convenient from floor level, but not less than full length of roller shade.

b. Limit Stops: Provide upper and lower ball stops.

c. Chain-Retainer: Manufacturer's standard plastic wall- or jamb-mounted retaining clip, designed for securing bead-chain when shades are not being operated.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and accommodate internal components of operating mechanism and the weight and widths of shadebands material without deflection; designed to be easily removable from support brackets. Provide capacity for one roller shade band per roller, unless otherwise indicated. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-end Location: Right side of inside face of shade, as determined by hand of user facing shade from inside, unless project conditions dictate left side installation, or indicated otherwise.

2. Direction of Shadeband Roll: Regular from back (exterior face) of roller.

3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube, allowing shadeband removal without removal of roller from brackets.

D. Mounting Hardware: Brackets or endcaps, minimum 1/8-inch thick steel, corrosion resistant and compatible with roller assembly, operating mechanisms, installation accessories, and installation locations and conditions indicated.

1. Mounting: As indicated on Drawings; permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated with one roller drive-end assembly.

F. Shadebands:

1. Light-Transmitting Shades:

a. Shadeband Material: Light-filtering fabric.

b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum enclosed in sealed pocket of shadeband material

2. Light-Blocking (Blackout) Shades:

a. Shadeband Material: Light-blocking fabric.

b. Shadeband Bottom (Hem) Bar: Extruded aluminum with endcaps and integral light seal for fitting into sill channel.

i) Color: As selected from manufacture's full range

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.

b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches.

c. Color: Custom color to match existing dark bronze door frames

i) Sheen: Semi-gloss.

2. Endcap Covers: To cover exposed ends of roller.

a. Color: Matching fascia

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric – Type 1: Woven fabric, non-reversible face, stain- and fade-resistant.

1. Source: Roller shade manufacturer

a. Product: MechoSystems; SoHo 1600 Series

2. Type: Woven PVC-coated polyester.

3. Weave: Basketweave.

4. Thickness: 0.024 inch.

5. Roll Widths: 63 inches, 96 inches, and 126 inches.

6. Orientation on Shadeband: Up the bolt, except as follows.

a. Where width of shadeband exceeds width of largest available roll, fabric to be railroaded with least number of seams possible.

7. Openness Factor: 3 percent.

8. Color: As specified in Section 09 06 00 "Colors and Finishes." retain this option if design team has selected colors(s), and Section 09 06 00 is being used to specify finish colors

2.4 ACCESSORY MATERIALS

A. Paint: Manufacturer's paint as recommended by roller shade manufacturer for application to exposed aluminum surfaces of roller shade unit.
   1. Color: Custom color to match paint chip provided by Architect
   2. Sheen: Semi-gloss.

2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less than 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or –floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
   2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
   1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than manufacturer's written recommendations, but not less than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion or the material.

D. Fabricate roller shade to allow removal of rollers from brackets without removal of brackets and other hardware from window opening or ceiling pocket.

E. Factory-Applied Color Finishes: For metal components exposed to view, apply manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Apply paint to exposed surfaces of roller shade units according to paint manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended in writing by paint manufacturer.
3. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 24 13

SECTION 22 00 00H

PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01.

B. The requirements of the General Conditions and Supplementary Conditions.

1.2 SUMMARY

A. Furnish and install a complete (fully tested, adjusted, and ready for operation) plumbing system as described by the Contract Drawings and Specifications.

B. The design described in the Project documents reflect a building designed for low consumption of energy and water and minimum environmental footprint. Any modifications to the systems described herein shall maintain or improve on the sustainability and energy efficiency features of the project.

C. All design modifications that pertain to system selection, system energy efficiency, water and energy use, material selection and indoor air quality issues shall require the approval of Integral Group.

D. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

E. Check, verify, and coordinate Work with Contract Drawings and Specifications prepared by all other trades. Include modifications, relocations, and adjustments necessary to complete work or avoid interference with other trades.

F. Where architectural features govern location of Work, refer to Architectural Drawings.

G. Contractor may install additional piping, fittings, and valves, not shown on the drawings, for testing purposes or convenience of installation. Where such materials are installed, they shall comply with the specifications and shall be properly sized for the system and operation. Remove such installed materials when they interfere with design conditions or as directed by the Architect.

H. Commissioning: The scope of work for the Contractor shall not include the duties of the Commissioning Authority (CxA). Contractor will be required, however, to include in their scope of work duties relevant to the commissioning process, including but not limited to training of owner's personnel in the operation of the plumbing equipment, providing manufacturer's startup and pre functional checklists and contractor-provided pre-functional and startup checklists to Commissioning Authority, performing and documenting pre-functional tests for plumbing equipment, performing and documenting functional tests for plumbing equipment, supporting DDC Contractor and Test and Balance Contractor in the performance of their duties, and providing operations and maintenance manuals. Refer to Division 23 "Commissioning of HVAC and Plumbing" for additional requirements.

1.3 CODES AND STANDARDS

A. All work and materials shall be in full accordance with the latest local rules and regulations, applicable sections of the California Code of Regulations, Title 24, State Fire Marshal, the Safety Orders of the Division of Industrial Safety, the California Electric Code and applicable

State requirements. Nothing in these Plans and Specifications is to be construed to permit work not conforming to these requirements.

B. Wherever the Specifications call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these Specifications shall govern. Should there be any direct conflict between the above rules and regulations and the Specifications the rules shall govern.

C. Equipment shall have UL label listing.

1.4 DRAWINGS

A. Layout of the equipment and work is diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. Any interference noted between different drawings, and between drawings and actual field conditions shall be brought to the attention of the Architect and Engineer of Record for a decision. The right is reserved to make any reasonable change in location of equipment without additional expense to the Owner.

B. For purposes of clarity and legibility, drawings are diagrammatic to the extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping and locations of equipment shall be governed by structural conditions and obstructions. Contractor shall make use of all data in Contract Drawings and Specifications and field conditions.

C. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, shop drawings of the proposed rearrangement. Because of the diagrammatic nature and small scale of the Contract Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the structural and finish conditions affecting all the Work and shall arrange such Work accordingly, furnishing such fittings, equipment, accessories, etc., as may be required to meet such conditions, at no increase in Contract Sum.

D. The construction documents for this project were prepared by the design team using BIM (Building Information Modeling). Using this software by the design team does not relieve the Contractor from performing the necessary coordination to provide complete, code compliant and operational building systems. The plans and sections provided are diagrammatic and show the design intent, these are not intended to be used for fabrication or installation. Contractor is responsible for generating shop drawings for fabrication that meet the design intent as shown on the Contract Documents. The exact location of the piping, electrical and support components are to be determined by the Contractor. All building sections and details provided are for information only and do not relieve the Contractor from performing final coordination. Contractor is responsible for coordinating with all other trades.

E. All dimensions and locations of equipment, doors, partitions, etc., are to be taken from the architectural plans but shall be verified at the site.

1.5 SUBMITTALS

A. See Division 01 “Administrative Requirements”, for submittal procedures.

B. Plumbing and related submittals are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.

C. Engineer of Record will review submittals and provide comments within the following timeframe after receipt by the Engineer:

1. For typical submittals, allow 10 working days.

2. For large or complex submittals, allow 15 working days. Determination of “large and complex” submittal shall be at the discretion of the Engineer of Record.

3. Do not send Engineer of Record more than 10 submittals in a contiguous period of 5 working days. If excess submittals are received, review period will be extended as necessary to perform proper review. Submittals will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.

4. These submittal review periods supersede and take precedence over periods defined in Division 01, unless Division 01 allows for longer review periods.

5. Submittal review periods shall not be reduced from the times herein except by agreement with the reviewing entity, in advance and in writing.

D. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Use the same identifiers (e.g. equipment tags) used in Contract Drawings.

E. Submittals shall be provided in digital format.

1. Provide a separate file for each submittal. For submittal packages, provide a separate file for each subsection (e.g. hardware cutsheets and shop drawings for the same Section shall be provided as separate files).

2. Product cutsheets, test forms and other text documents shall be provided in word searchable digital format. Acceptable formats are MS Word, PDF (generated from another electronic document and word-searchable; scans of paper documents are not acceptable), and HTML; other formats require approval prior to submission.

3. Drawings and schematics shall be provided in PDF format and in AutoCAD compatible format.

4. Scanned paper documents are not acceptable

a. Exception: original signed documents, such as qualifications, inspection certificates, and warranty documents.

5. Hardcopy (paper) submittals are not acceptable and shall not be provided except as noted in Article 1.2).

6. Submittals provided in the wrong format will be returned without action.

F. Submission and Resubmission Procedure

1. Optional Pre-Submittals: At Contractor’s option, material may be submitted unofficially via email directly to the Engineer of Record for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time, and to provide a venue to discuss technologies, products, designs or implementation strategies that are novel or unique.

2. Each submittal shall have a unique serial number that includes the associated Specification Section followed by a number for each sub-part of the submittal for that Specification Section, such as SUBMITTAL 220000-01. There is no requirement to assign particular serial numbers to any specific submittals – serial number assignment is

arbitrary. The only requirements are that the serial numbers be sequential (to avoid confusing gaps) and, most importantly, consistent across all submittal correspondence.

3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 220000-01 REVISION 1.

4. Submit one copy of submittal in electronic format specified in Paragraph 1.5E. Submissions made in the wrong format will be returned without action.

5. Include with each submittal and resubmittal a copy of the relevant specification section(s) noting on each paragraph and sub-paragraph(s) the following:

    a. CONFORMS: Contractor has verified that the submitted product conforms to the noted requirement(s).

    b. CONFORMS AS NOTED: Contractor has verified that the submitted product conforms to the noted requirement(s) by means of being equal to or higher quality and / or performance.

    c. NON-CONFORM: Contractor has verified that the submitted product does not conform to the noted requirement(s) and delineates each deviation from the specification requirements.

    d. NOT APPLICABLE: Contractor has verified that the noted requirement(s), in their opinion do not apply to this product, delineating the reasons for this decision.

    e. Include with each submittal and resubmittal a copy of the relevant specification section(s) the printed name of the contractor reviewer, their signature, the company name, and date of review.

6. Revise submittal

    a. Respond to all comments:

        1) Revise initial submittal to resolve review comments and corrections.

        2) Provide complete responses to comments or suggestions which are not practical to implement in the opinion of the Contractor.

    b. Indicate any changes that have been made other than those requested.

    c. Clearly identify resubmittal by original submittal number and revision number.

    d. Resubmittals that are not responsive to all comments will be returned without action.

7. Resubmit revised submittals until no exceptions are taken.

8. Once submittals are accepted with “No Exceptions Taken” or “Approved As Noted”, provide:

    a. Complete submittal of all accepted drawings and products in a single electronic file.

    b. Copies for coordination with other trades, if and as required by the General Contractor or Owner’s Representative.

G. Submit shop drawings, a list of proposed material and equipment manufacturers and the names of Subcontractors.

H. Shop drawings shall be provided for all plumbing systems for all floors of the building. Plumbing shop drawings shall also be provided for the underslab systems (under the foundation slab) and slab-embedded systems such as floor drains.

I. Materials and methods with which the words “for approval” or “approved” are used, and materials and methods which differ from those specified, shall be submitted.

J. Prepare and submit shop drawings, sections, details and diagrams to minimum scale 1/4” = 1’-0”. Drawings shall be coordinated, dimensioned and indicate equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers, etc. Electronic submittal is encouraged.

K. Submit manufacturer’s specifications, product source, data sheets, certified equipment drawings and installation instructions, including installation dimensions, clearances, weights, materials, finishes, color selection, accessories, acoustical characteristics, capacity and full load and part load performance curves; complete with electrical data, motor horse power, kW; motor efficiency, amperage, voltage phases and wiring diagrams. Identify the particular specification section number, paragraph and equipment identification number per equipment schedule. Note that suppliers (wholesalers and distributors) data sheets are not acceptable unless they are also manufacturers of the product being submitted.

L. Pump systems, with equipment in parallel, shall have performance curves noting single equipment operation and all iterations of additional equipment.

M. Certified Equipment Drawings (8-1/2” x 11” sheets) shall be indexed in accordance with Specification Section. Drawings to be submitted at a later date shall be marked with a page as a placeholder for insertion when submitted. The original submittal shall note which shop drawings will be submitted later. Marked-up catalogs are not acceptable and will be returned without action. Electronic submittal is required.

N. Engineer of Record’s review of submittals is for limited purpose of verifying conformance with information given and design concept expressed in Contract Drawings and Specifications. Engineer’s review is not for purpose of determining accuracy or completeness of items such as dimensions and quantities, which remain responsibility of Contractor.

O. Contractor shall not commence with fabrication or installation of any equipment or system until the associated submittals have been approved by the Engineer of Record and returned with “no exceptions” taken. Contractor shall be solely liable for any costs incurred from starting fabrication before approved submittals are returned.

P. All final approved submittals and equipment datasheets shall be provided, in PDF format, to the owner as part of the as-built drawing set and shall be text searchable.

1.6 COORDINATION DRAWINGS

A. Utilize the latest version of 3D AutoCAD, Navisworks, and/or Revit software for the Coordination Drawings. No proprietary software of any kind shall be used other than that indicated. Drawing paper size shall not be larger than FULL SIZED Contract Drawings, and in no case larger than 30” x 42”. Coordinate available space with ALL other trades involved.

B. Provide Coordination Drawings in digital electronic format. Provide both native file format (AutoCAD, Navisworks, or Revit) and PDF format files. Hardcopy drawings are not acceptable.

C. These drawings are to show pipe sizes, valves and accessories, elevation of bottom of pipe, all elevations of materials and/or systems throughout each floor inclusive of hanger

components, seismic bracing if applicable, and any component of construction that impacts vertical and/or horizontal space. In addition, the locations of all valves and other items requiring access for service and maintenance are to be shown. The drawings are to also show electrical, structural beams, architectural bracing, structural bracing, ceiling heights, access doors, walls, floor to floor dimensions, columns, doors and other major architectural and structural features as shown on the architectural and structural drawings. Where the routing of work differs from that indicated on the Contract Drawings, such areas are to be indicated by highlighting with a note describing the reason for the change.

D. Rerouting of any system or part thereof shall be submitted separately in order to obtain concurrence of the Engineer of Record. Submitted rerouting must include fully documented proposed solutions with all trades coordinated. Contractor is fully responsible for coordination of systems included herein. Any effort by Engineer of Record beyond answering Contractor's questions will be at Contractor's expense, including attending coordination meetings, review of interim plans, or review of incomplete questions (routing issues without suggested solutions).

E. The Contractor and subcontractors are responsible to review and resolve any real or apparent interferences or conflicts as indicated by the coordination drawings produced by each trade.

F. After all conflicts or interferences are resolved, develop a final composite drawing showing the agreed upon routing, layout and juxtaposition of all piping, major conduit, valves, panels, lighting fixtures and all other major mechanical, plumbing and electrical installations. In the preparation of all the final Coordination Drawings, large scale details as well as cross and longitudinal sections are required to fully delineate all conditions.

G. Submit the Coordination Drawings as digital electronic files to Engineer of Record for review and comment, as indicated under "Shop Drawings" above. Coordination Drawings shall be digitally signed-off by all other trades.

H. Contractor shall not commence with fabrication or installation of any equipment or system until the associated shop drawings have been reviewed and returned by the Engineer of Record. Engineer's review of shop drawings shall not be taken as approval of their contents. Contractor shall be solely liable for any costs incurred due to deviations from the Contract Drawings.

I. No extra compensation will be paid for relocating any pipe, duct, conduit, or other material that has been installed without proper coordination between all trades involved. If any improperly coordinated work, or installed work that is not in accordance with the approved coordination composites, or is specifically noted by the Architect or Engineer of Record for a valid reason, necessitates additional work by the other trades, the costs of all such additional work is to be borne solely by the Contractor.

J. All changes in the scope of work due to revisions formally issued and approved are to be shown on both the individual subcontractor's Shop Drawings and the Coordination Drawings.

1.7 REQUESTS FOR INTERPRETATION AND CLARIFICATION

A. See Division 01 "Project Management", for RFI procedures and forms.

B. Plumbing RFIs are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.

C. Limit each RFI to a single issue or group of related issues.

D. Each RFI shall include a workable no-cost or lowest cost solution recommendation by Contractor.

E. Allow three (3) working days from time of RFI receipt by Engineer of Record for review and response.

F. Do not send Engineer of Record more than 10 RFIs in a contiguous period of 5 working days. If excess RFIs are received, review period will be extended as necessary to provide a professional response. RFIs will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.

1.8 MATERIALS AND SUBSTITUTIONS

A. Comply with Division 01 “Product Requirements”.

B. Requests for product or equipment substitution shall be accompanied by a marked up copy of the Engineer of Record’s original specification. For each specified product feature or requirement, Contractor shall note the equivalent feature or attribute of the proposed substitute product or equipment.

C. Shop drawings of proposed material and equipment that differ from the specified materials and equipment, shall be accompanied by drawings that define changes. These drawings shall show modifications of architectural, plumbing, electrical and mechanical work required by the proposed materials and equipment, such as relocation of flues, drains, revised electrical circuits, relocation of roof or wall penetrations, revised foundations, etc.

1.9 COORDINATION WITH OTHER WORK

A. Contractor performing Work under this Section shall become thoroughly familiar with the Drawings and Specifications. Contractor shall adjust the Work to conform with the conditions shown on these drawings to provide the best possible assembly of the combined Work.

B. Obtain necessary information from the other trades regarding location of their work in order that the Work in this Section may be placed in correct position.

C. The inclusion and proper location of supports, pads, sleepers, openings, anchorages, etc. provided by others is the responsibility of the Contractor under this Section. Cutting and/or boring shall be permitted under this Section only with the written approval of the Architect.

D. It shall be the Contractor’s responsibility to coordinate and have provided by other trades where not covered by the Contractor’s scope of work, all electrical wiring and power to equipment, controls and devices, and any other work from other trades as required to provide fully functioning plumbing systems per the Contract Drawings and Specifications.

1.10 MANUFACTURER’S DIRECTIONS

A. Manufacturer’s directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Contract Drawings and Specifications.

1.11 PROTECTION OF WORK

A. Equipment and materials shall be stored on dunnage and remain wrapped at all times until installed.

B. Duct and piping shall be remain capped during delivery and storage.

C. During installation, all installed duct and piping shall be capped and protected at the end of each working day.

D. Equipment shall be protected from weather and stored in an enclosed, indoor location.

E. Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

1.12 WORKMANSHIP

A. Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Architect or Engineer of Record, be removed and replaced in a satisfactory manner, without change in Contract Sum or additional cost to the Owner.

1.13 CLOSING IN UNINSPECTED WORK

A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect, Engineer of Record, and/or Commissioning Authority.

B. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the Owner.

1.14 EQUIPMENT ANCHORING

A. Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes.

1.15 PRELIMINARY OPERATION

A. Under this section, Contractor shall supervise and direct preliminary operation of systems should the Owner demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses for such preliminary operation will be paid by the Owner. Such preliminary operation or payment shall not be construed as an acceptance of the work.

1.16 CUTTING AND OPENINGS

A. Comply with Division 01 “Cutting and Patching”.

1.17 “AS-BUILT” DRAWINGS

A. Comply with Section Division 01 “Project Closeout”.

B. As-built drawings shall be furnished in an electronic format. Provide in drafting software (AutoCAD or Revit) native format and also in PDF format.

1.18 FINAL INSPECTION

A. At the time of final inspection, a service representative shall be available to make final adjustments.

1.19 FINAL OPERATION

A. After acceptance of the installation, instruct the Owner’s Representative in operation and maintenance, for a period of three (3), non-consecutive working days at a time requested by the Owner during the first year of warranty.

B. At the beginning of the instruction period, deliver to the Owner three (3) copies of a durable binder as described under “Operating Instructions”.

1.20 OPERATING INSTRUCTIONS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these Specifications.

B. Division 22 shall compile and prepare documentation for all equipment and systems covered in Division 22 and deliver this documentation to the General Contractor for inclusion in the O&M manuals prior to the training of Owner personnel.

C. Provide a summary of operating sequences (start-up, normal run, and shut-down), and control shop drawings in the main mechanical room.

D. Provide three (3) complete sets of Operating Instructions. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists. See Article 1.19 “Final Operation”.

E. Provide a copy of the O&M manuals to the Commissioning Authority for review.

1.21 TRAINING OF OWNER PERSONNEL

A. The General Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The Commissioning Authority (CxA) shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

C. The Plumbing Contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan two weeks before the planned training.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment including, but not limited to, pumps, heaters, controls, water treatment systems, etc.

3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer’s representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

7. Training shall include:

a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discussion of relevant health and safety issues and concerns.

d. Discussion of warranties and guarantees.

e. Common troubleshooting problems and solutions.

f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

g. Discussion of any peculiarities of equipment installation or operation.

h. Instruction in the use of equipment controls that are integral to equipment or are provided by the equipment manufacturer. Equipment controls training shall include at least the following:

1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system and any interface with security and communication systems.

2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.

3) If system supports trending, all trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.

4) Every screen shall be completely discussed, allowing time for questions.

5) Use of keypad or plug-in laptop computer for mobile control access.

6) Use of remote access to the system via phone lines or networks, if applicable.

7) Graphics generation, if applicable.

8) Point database entry and modifications, if applicable

i. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.

j. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate. A video record of the training session is suggested but not required. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.

8. The Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

9. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

1.22 WARRANTY

A. In accordance with Division 01 Project Closeout requirements, Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.

B. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship, or finish.

C. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a minimum period of one (1) year from date of Certificate of Occupancy, or per Division 01, whichever is longer.

D. Warranty also services including instructions, adjusting, testing, noise, balancing, etc.

E. For each piece of equipment or device with a manufacturer's warranty in excess of one year, Contractor shall furnish certificate of manufacturer's warranty and contact information for manufacturer's warranty service. Contractor shall also provide a list or table of all equipment with warranties exceeding one (1) year in duration.

F. Provide new materials, equipment, apparatus, labor and/or service, and support to correct or replace that determined by the Owner to be defective or faulty.

G. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.

H. After a period of 90 calendar days from date of acceptance of systems by Owner, provide, at no cost to the Owner, one service mechanic for an 8-hour period over as many working days as required to repair, replace any latent deficiency.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 22 00 00H

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 23: HVAC
4. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
    a. Test samples for lead content by the atomic absorption spectrophotometry method.
3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.

A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. ANSI - American National Standards Institute.
2. ASME - American Society of Mechanical Engineers.

a. ASME Boiler and Pressure Vessel Code.

b. ASME B31 - Standards for Pressure Piping.

3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.

4. ASTM - American Society for Testing and Materials.

a. ASTM A53 Specification for Welded and Seamless Pipe.

5. AWWA - American Water Works Association.

6. CSA - Canadian Standards Association.

7. FM Global - Factory Mutual Global

8. IAPMO - International Association of Plumbing and Mechanical Officials.

9. NFPA - National Fire Protection Association.

10. OSHA - Occupational Safety and Health Administration.

11. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.

12. UL - Underwriters Laboratories Inc.

13. Intertek (ETL Certification).

B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:

1. CBC, California Building Code, and CMC, California Plumbing Code.

a. Latest edition as adopted by the City of Los Angeles, the County of Los Angeles, and the State of California including amendments effective on the Effective Date of the Contract.

2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.

3OSHA - Occupational Safety and Health Administration.

4. CDPH - California Department of Public Health.

5. SCAQMD - South Coast Air Quality Management District.

C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.

D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.

B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.

C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3113: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3113 and Section 01 3300 and shall indicate at a minimum:

1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 3113.

2. Schedule and description of equipment, piping and fittings.

1.04 PROJECT RECORD DOCUMENTS

A. Comply with provisions of Section 01 7700: Contract Closeout.

B. Project Record Drawings:

1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.

2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.

C. Operation and Maintenance Manuals:

1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.

2. Contents of Manual:

a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.

b. Manufacturer's operating instructions including, but not limited to, the following:

1) Identification of components and controls.

2) Trouble shooting checklist and guidelines.

3) Recommendations for optimum performance.

4) Warnings and safety precautions on improper or hazardous operational procedures or conditions

c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:

1) Manufacturer’s model, identification and serial numbers.

2) Exploded view of assembly drawings identifying each component or part with the relevant part number.

3) Directory of manufacturer’s representatives, service contractors and part distributors.

4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.

d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.

e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 23 0593.

f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.

g. Los Angeles County industrial waste permits.

h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.

i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.

B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.

B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

A. Training of Owner’s personnel shall include:

1. A minimum of 4 hours of on-site overview of the overall Plumbing System.

2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.

B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.

C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.

D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.

E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.

B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.

C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

D. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.

B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.

C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.

B. Where pipes pass through or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.

C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.

B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.

C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.

D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

A. Tests shall be as required under the applicable sections of Division 22, including this Section.

B. Additional tests may be required in the case of products, materials, and equipment if:

1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.

2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.

C. Piping Tests:

1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.

2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.

3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.

4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.

5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.

6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.

7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

D. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Durham system, glass or plastic acid waste, vent and roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent; allow to stand two hours, or longer, as required by Inspector. Minimum head required for any joint shall be 10 feet in building.	Water
Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	10 feet of water, vertically	
Storm water disposal lines	Running water test	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Domestic water piping	200	Water
Standpipes, wet or dry	300	Water
Fire sprinkler piping	200	Water
Gas piping(steel threaded or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	Air
Gas welding station	1-1/2 Working pressure 100 min.	Dry nitrogen
Compressed air piping	175	Air

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.

2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.

3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.

4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.

   a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.

5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.

6. Provide electric energy and fuel required for tests.

7. Final adjustment to equipment or systems shall meet specified performance requirements.

8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

F. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.

2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.

3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 0513: Basic Plumbing Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level

B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:

1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.

2. Protect installed Work.

3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.

4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.

5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.

6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.

7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

END OF SECTION

SECTION 22 05 13

BASIC PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.

2. Division 22: Plumbing.

3. Division 26: Electrical.

4. Section 33 1100: Site Water Distribution Utilities.

1.02 SUBMITTALS

A. Provide in accordance with Division 01, Section 22 0500 and specific requirements of each section of Division 22.

B. Types of welding rods to be used.

1.03 QUALITY ASSURANCE

A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.

B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.04 COORDINATION

A. Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.

B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 0500, manufacturer's instructions or as required.

1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

A. Ball Valves: Bronze, 2-inch and smaller:

BV-1: Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

Provide valve Handle shall be stainless steel when valve is installed below grade or in the ground valve box.

BV-2: Class 150, 600 psi, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

NIBCO T-685-80-LF, Hammond UP-8303A, Milwaukee UPBA-400 or equal.

NIBCO T585 S6R66 (Stainless Steel), Milwaukee BA-260 (Stainless Steel).

Provide BV-1A shall be used on hot domestic and cold water systems.

BV-3 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, or equal.

Provide BV-2 to be used only where water is NOT used for water consumption.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conducive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

B. Butterfly Valves:

Provide Butterfly Valves in a domestic plumbing system intended to convey water for

human consumption shall comply with Quality Assurance, article 1.03 of this Section.

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.

2. Disc: Bronze, or aluminum bronze.

3. Stem: One or two-piece, 400 series stainless steel.

4. Seat and O-Rings: EPDM.

5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.

6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8 inches and larger, with manual gear operator and disc position indicator.

7. Manufacturers:

   a) Valves 2.5 to 6-inch: NIBCO, Milwaukee ML-233E, Hammond 6411-03, or equal.

   b) Valves 8-inch and larger: Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000, or equal.

C. Check Valves:

Provide check valves in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03 of this Section.

1. Bronze, 2-inch and smaller:

CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904 or equal.

Provide on domestic hot and cold water systems.

CHV-2: Class 125 200 psi, swing check, bronze body, Teflon disc, soldered ends.

Stockham B-310TY, Crane 1340, NIBCO S-413-Y, Milwaukee 1509-T, Hammond IB-912 or equal.

Provide on junior fire sprinkler systems less than 3 fire sprinkler heads.

CHV-3: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Nibco S-413-Y-LF, Milwaukee UP 1509-T, Hammond Up-946 or equal.

Provide on domestic hot and cold water systems.

2. Cast Iron 2 1/2-inch and larger:

CHV-4: Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, threaded ends:

Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

Provide on multiple domestic hot and chilled water pump systems, multiple steam boiler return lines from steam trap.

CHV-5: Special low-pressure check valve for installation in gas lines.

Circle Seal Products Co.
119B-PP-0-15 psi; #1:1/8 inch IPS; #2:1/4 inch IPS #3:3/8 inch IPS.

Provide on low pressure gas in chemistry laboratory systems.

D. Gate Valves:

Provide gate valves in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03.

1. Bronze, 2-inch and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

Provide shut-off and isolation of equipment and device for gas system.

GV-2 Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

NIBCO T-113-LF, Milwaukee UP 105, Hammond UP 645 or equal.

Provide on domestic hot and cold water systems.

GV-3 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647, or equal.

Provide in yard box, to each group of fixtures behind access panels, where valves are located near ceiling and beams.

GV-4 Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

NIBCO T-113-LF, Milwaukee UP 105, Hammond UP 645 or equal.

Provide on domestic hot and cold water systems.

GV-5 Class 125, 200 psi WOG, rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Stockham B-100, Crane 428, NIBCO T-111, Milwaukee 148, Hammond IB-640, or equal.

Same as GV-3 except where clearance is not an issue. Adequate clearance for operation must be provided because hand wheel and stem rise. Provide inlet and outlet connections to water heaters and pumps, make up water lines to HVAC equipment and expansion tanks.

GV-8A Class 250, 250 psi, CWP, O S and Y, IBBM, resilient seat gate valve, flanged ends.

Watts 408-OSY-RW, Kennedy 7168 or equal.

The epoxy coated valves are recommended in the domestic cold water system where corrosives in the water line might cause damage to the inside of valve and where pressure rating in excess of 200 psi is required.

GV-9 Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

Provide in walls for cold water system pipe sizes 2 ½-inch and larger.

NIBCO F-619-RW or equal.

GV-10 Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated.

Provide for using below grade for cold water system pipe sizes 2 ½-inch and larger.

NIBCO F-619-RW-SON or equal.

E. Globe Valves:

1. Bronze, 2-inch and smaller:

Provide in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance of Article 1.03.

GLV-1A Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Milwaukee UP 502, Hammond UP 440 or equal.

GGLV-2 Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, solder ends.

Hammond IB-418, Milwaukee 1502, NIBCO S-211-Y, or equal.

GLV-2A: Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, soldered ends.

Milwaukee UP 1502, Hammond UP 418 or equal.

Provide on domestic hot and cold water systems.

F. Piping:

PROVIDE FOR PIPES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPY WITH QUALITY ASSURANCE ARTICLE 1.03.

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.

P-1 Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO 1S 06. American Foundry, Tyler, or AB & I or equal.

P-2 Galvanized steel, Schedule 40, ASTM A53., US Steel or equal.

P-3 Copper drainage tube, underground, type L hard, ASTM B 88, Mueller, Cerro Brass or equal.

P-4 Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306, Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead or equal.

P-5 Purple pipe, PVC, schedule 40 for reclaimed or recycled water (below ground only for non-potable irrigation systems), type 1, grade 1, PVC-1120, Cell Class 12454 B.

P-6 Copper water tube, Type L hard, ASTM B88. Mueller, Cambridge-Lee, Halstead or equal. (when used above ground only)

P-7 Copper water tube, Type K hard, ASTM B88, by Mueller, Cerro Brass, Cambridge-Lee, Halstead or equal.

P-8 Polyethylene plastic pipe, ASTM D 2513, standard dimension ratio. 11, rated at 80 psi working pressure at 73 degrees Fahrenheit (F). for 3-inch and smaller, SDR

11.5 rated at 76 psi at 73 degrees F. for 4-inch and above, butt or socket type fittings, joined by heat fusion, orange or yellow color.

CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

Provide for natural gas below grade only. Transition to anodeless steel riser at meter, regulator, or building wall.

P-9 Red seamless brass 85-5-5-5, iron pipe size (IPS), threaded pipe, ASTM B43. Mueller, Cerro Brass, Cambridge-Lee, Halstead or equal.

P-10 Black steel pipe, Schedule 40, ASTM A53, Type E, ERW by US Steel, or equal.

P-11 Seamless copper tubing, tempered drawn, Type M, ASTM B88 by Mueller, Cerro Brass or equal.

G. Pipe Fittings:

Pipe fittings in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03.C.

PF-1 Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 ½-inch thru 4-inch, IAPMO, ASTM C 564 and CISPI 310.

American Foundry, Mission, Tyler, or equal.

PF-2 Cast iron, soil or waste, Heavy-duty no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 4 bands for size 5-inch thru 10-inch. IAPMO, ASTM C564 and CISPI 310.

American Foundry, Mission, Tyler, or equal.

PROVIDE WITH P-1 AS REQUIRED BY THE ENGINEER DUE TO SITE SPECIFIC CONDITIONS.

PF-3 Malleable iron, Class 150, threaded, galvanized, beaded, ANSI B 16.3. P-2

Stockham, Stanley Flagg, Grinnell Oreual.

PROVIDE WITH P-2.

PF-4 Cast brass drainage fittings ASA B 16.23, ASTM B 42. Provide with copper drainage tube.

Mueller Brass, Nibco, Stanley Flagg, Lee Brass Or equal.

PROVIDE WITH P-3 AND P-4.

PF-5 Wrought copper - solder type ANSI B 16.22

Mueller Brass, Nibco, Lee Brass or equal.

PROVIDE WITH P-6 PIPE, SOLDER, AND FLUX SHALL BE LEAD-FREE FOR DRINKING WATER. FLUX SHALL BE AN APPROVED WATER-SOLUBLE MATERIAL.

PF-6 Polyethylene plastic fittings, ASTM D 3261 and D 2683, standard dimension ratio 11, rated at 80 psi working pressure at 73 degrees F. for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4 inches and above, butt or socket type fittings, joined by heat fusion, color orange or yellow.

CPCHEM, (Chevron Phillips Chemical Company LP) or equal.

Provide with P-8.

PF-7 Polyethylene transition risers, for Pff-6 above, Transition fitting must have a minimum vertical height of 36 inches from the horizontal connection which will allow for a 6-inch steel riser above ground. Polyethylene transition risers shall be anodeless.

Central Plastics Company or equal.

Installed in a gas piping system for the purpose of providing a transition from horizontal below ground (polyethylene) to a vertical above ground (steel). Transition must be made on the horizontal side of the gas piping system and meet ASTM standards for Polyethylene plastic pipe and fittings.

PF-8 Bronze and brass, 250 psi, threaded, ASA B16.17 and F S WW-P-460.

PROVIDE WITH P-9.

Mueller Brass, Lee Brass Or equal.

PF-9 Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 2-inches and below and welded for 2 ½-inch and above, by Stockham or equal.

PROVIDE WITH P-10.

PF-10 Cast iron, threaded, Class 125, ANSI B 16.1.

PROVIDE WITH P-12.

Stockham or equal.

PF-11 Cast-iron OD sized, bell and spigot gasket joints.

H. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe.

Provide for copper piping.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 PLASTIC CUSHION TO FORM AN INSULATING LINER AND ELIMINATE METAL TO METAL CONTACT WHEN SECURING COPPER TUBES AND PIPES IN AIR CONDITIONING AND REFRIGERATION INSULATION PREVENTING GALVANIC EROSION. (ACOUSTICAL TYPE FOR SOUND ABSORPTION).

Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

I. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss, or equal.

J. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc; by Walworth, Homestead, WKM, or equal.

Provide Isolation and on-off application for gas system.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc. Walworth, Homestead, WKM, or equal.

K. Safety Relief Valves:

SRV-1 Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Watts 40L Cash-Acme NCLX-1

Provide for Steam system, hot water system.

SRV-2 Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Watts 10 x L, Cash-Acme NCLX-1

SRV-3 Spring type, ASME and NB stamped and certified with manual lifting device for air or gas.

Bailey, Cash-Acme, Watts, Keckley or equal.

Provide for Gas system and compressed air system.

L. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
   C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley 'B', Spirax Sarco Y-type, or equal.

2. 2 ½-inch and larger:
   C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

   C.M. Bailey, Armstrong, Muessco, Keckley 'A', or equal.

   Provide for Oil and gas systems.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.

2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley or equal.

Provide as same as STR-1.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Bailey No.1, Zurn 150 Series, RP&C, Keckley GFV or equal.

Provide for Domestic cold and hot water system. Mount above grade for water service.

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

Provide for Domestic hot and cold water system except for high pressure system.

M. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Stoneman Engineering and Mfg., Semco 1550

Provide for Sanitary drainage system.

N. Vacuum Valves:

VV-1 Vacuum valves; for vacuum serve, 125 psig working pressure, cast iron body, spring loaded lubricated plug type.

General Controls, Honeywell, Valmatic, or equal.

Provide for Domestic hot and cold water system.

O. Protective Coating for Underground Steel Piping Applied to Underground Automotive:

VV-1 Vacuum valves; for vacuum service, 125 psig

Provide for WORKING HOIST PIPING ONLY.

1. Black steel or galvanized steel piping indicated for below grade installation, shall be protected as specified prior to delivery to the Project site:

    a. Sandblast black steel pipe to a gray finish. Sandblast galvanized steel pipe lightly only.

    b. Install one coat of cut back asphalt to galvanized pipe immediately after sandblasting. Pre-heat black pipe to 180 degrees F. immediately before coating.

    c. Install one coat of high-temperature (melting point of 240 degrees F. minimum) Grade B asphalt enamel.

    d. Install one wrapping of 20 mils thick glass, fiber mat, Owens-Corning Coromat or L.O.F. Blueflag with 1/4 inch overwrap. Glass fiber shall be dry at time of installation.

    e. Install a second coat of asphalt enamel as specified above. Glass fiber mat shall be centered in the asphalt enamel.

    f. Install an overwrap of Kraft ripple paper.

2. Total thickness of pipe wrapping shall be not less than 1/8 inch. Entire coating operation shall be accomplished by mechanical means in a continuous operation. Hand installation of protective coating is not permitted.

3. Each piece of wrapped pipe shall be legibly identified at no greater than 5 feet intervals by fabrication company. Each material submittal shall include the name of the fabrication company. Maintain one reviewed Sample on the Project Site.

4. Acceptable manufacturers of wrapping are: Hunt, Mobile, Conway or equal.

5. Fittings (including couplings), unprotected pipe adjacent to fittings, and damaged pipe protection shall be wrapped at Project site as follows:

   a. Fittings and pipe to be wrapped shall be thoroughly cleaned of material foreign to pipe manufacturer.

   b. Install one coat of Plicoflex No. 105 or Protecto Wrap No. 1170 adhesive primer to metal.

   c. Wrap pipe and fittings with a minimum thickness of 3/32 inch of Plicoflex No. 310 pipe line butyl molding tape, or Protecto Wrap No. 200 molding tape. Install 3 layers, each layer overlapping next approximately 2/3 width of tape, without stretching. Tape and primer shall be of the same manufacturer.

   d. Wrap vinyl tape, 10 mil thickness, over molding tape with 1 inch minimum overlap.

      J.M. Trantex, 3M Scotchwrap or equal.

5. Pipe and fittings specified to be wrapped shall be tested with a holiday detector, after pipe has been installed in trench and before backfilling, in presence of the Project Inspector. Furnish a Tinkler and Raser model E-P holiday detector, or similar equipment for this test. Work, which is deemed defective, shall be repaired or replaced. The Project Inspector may test for damaged pipe wrapping after backfilling.

6. Instead of wrapping underground steel pipe as specified above, pipe may be machine-wrapped before delivery to the Project site as follows:

   a. Pipe shall be cleaned of moisture, oil, grease, scale, and other foreign material by cleaning with non-oily solvent and wire brushing. Remove metal burrs and projections.

   b. Install one coat of Plicoflex No.105 adhesive primer to cleaned pipe. If thinning is required, furnish only non-oily thinners as recommended by tape manufacturer.

   c. Wrap coated pipe with Plicoflex No.340-25 tape (15 mil butyl and 10 mil vinyl laminate) Tape shall be installed by machine wrapping at approved plant only. Maintain tension (minimum of 5 pounds per inch of width) on tape over entire diameter of pipe. Tape shall be permanently identified and visible on vinyl side.

   d. Fittings, unprotected pipe, and damaged pipe protection shall be wrapped as indicated above.

P. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I

PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Domestic hot and Cold water, underground	Up To 8 inches	P-6	PF-5
Copper, underground only		P-7	PF-5
Cold water, underground (Site piping)	4-inch and over	P-1	PF-11
Domestic hot and cold water, in building and above ground	All	P-6	PF-5
In building above ground	2 to 8-inch	P-6	PF-5
Compressed air	Underground or in concrete	P-9	PF-8
	Above ground	P-10	PF-3
Condensate drains and drains From HVAC Equip.		P-6	PF-5
Downspouts, interior above and below grade, up to 5 feet from building.		P-1	PF-1 Or PF-2
Acid Vent	All	P-12	PF-10
Fire Mains (Fire Hydrant)	Underground	P-15	PF-11
Gas Natural	Underground	P-8	PF-6
Gas Natural	Above ground	P-10	PF-9
Copper Drainage Tube (Underground)	Waste and Vent	P-3	PF-4
Copper Drainage Tube (Above Ground)	Waste and Vent	P-4	PF-4
Vents	New Building	P-1	PF-1 or PF-2 (IRE) if required by engineer
Vents	Existing Buildings and Exposed Downspouts	P-2	PF-3
Waste lines, Sanitary		P-1	PF-1 or PF-2 (IRE) if required by engineer

Q. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125 pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.

Welded or grooved steel pipe, except high pressure steam lines.	150 pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule

SERVICE	TYPE
Cold water	1/16 inch thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

R. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
   a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
   b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
   c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
   d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.

B. Pipe Installation:

1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.

2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.

3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.

4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.

5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.

6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.

7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect or indicated on Drawings.

8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.

9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.

10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.

11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an

objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for Plumbing.

12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.

13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

   FOR FIRE RATED WALL PENETRATIONS FOLLOW THE UNIFORM BUILDING CODE.

2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.

3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.

4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.

5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.

6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.

7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 4000 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where

pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.

8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.

2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.

3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer and has performed type of work described by qualification in the preceding 3 months.

   REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.

   ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:

   a. Cracks of any type.

   b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.

   c. Elongated slab inclusions longer than 1/4 inch.

d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.

e. Undercuts greater than 1/32 inch.

f. Overlaps, abrupt ridges or valleys.

2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.

3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

   REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.

6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification and shall repair or replace said welds in accordance with specified requirements.

F. Welding Rods: Submit a written list of materials and proposed type of welding rods.

G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.

H. Qualification Tests for Low-pressure Welding:

1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.

2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure

Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.

3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.

4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.

5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.

2. Hot tapping of gas lines is strictly prohibited.

2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:

a. Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.

b. Plastic Piping: Teflon pipe joint compound tape.

c. Oxygen Piping: Wash treads with S.P., rinse, blow-dry and apply litharge and glycerine.

d. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.

b. Other services furnish sealant, suitable and as reviewed by the Architect.

3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.

4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.

5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.

K. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.

2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.

3 Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.

4. Do not overheat piping and fittings when installing silver brazing.

5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed, and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.

6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.

M. Welded Pipe Joints:

1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.

2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.

3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.

N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.

P. Polyethylene (Plastic) Pipe:

1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.

2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe and gas supply steel pipe of riser outlet, R. W. Lyall Co., or equal. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.

3. Connections to Existing Pipe Line or Branch:

a. Steel-to-plastic (PE): Provide manufacturer's prefabricated standard transition fitting, transition from epoxy-coated steel pipe to plastic, R. W. Lyall Co., or equal.

b. Plastic-to-plastic, PVC to PE: Provide manufacturer's prefabricated standard transition fitting, transition from PVC to epoxy-coated steel pipe to PE; R.W. Lyall Co., or equal.

c. Plastic-to-plastic, PE to PE: Provide manufacturer's standard fused tapping tee assembly with shut-off feature.

4. Provide PE reinforcing sleeves where PE pipe is fused to multi-saddles, service punch tee, reducing tees, transition fittings and anodeless risers.

Q. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.

2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.

3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.

4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.

5. Valves for similar service shall be of one manufacturer.

6. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman, or equal.

7. Ball valves below grade in yard boxes shall have stainless steel handles.

8. Hose bibs in dense garden areas shall be ¾ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be ¾ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.

9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:

    a. On discharge side of each pressure-reducing valve.

    b. On each water heater connected to a hot water storage tank and other pressure vessels.

    c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.

    d. On discharge side of each air compressor.

    e. On each air receiver connected to an air compressor.

10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it

connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:

11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.

12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.

R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.

S. Hangers and Supports:

1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.

2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.

3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.

4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.

5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.

6. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.

7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.

8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

   a. Tolco I beam, Fig.62 for maximum 1000 pounds.

   b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.

9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

   a. Tolco Fig.310 for maximum of 600 pounds.

   b. Tolco Fig. 309 for maximum of 1140 pounds.

10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.

11. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes ½ inch through 2-inch, ½ inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and ¾ inch for 8-inch and 10-inch pipe.

12. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.

13. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.

14. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.

15. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.

16. Vertical Piping:

    a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.

    b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.

    c. Copper tubing sizes 1 ¼-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.

    d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

17. Horizontal Piping:

    a. Pressure piping on roofs shall be supported from stands, trapezes, or structures so that the bottoms of pipes clear the roof surface by 10 inches.

    b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278, or equal.

    c. Domestic cold water piping, water supply and return piping, condenser water piping, insulated refrigerant piping gas piping, compressed air piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.

    d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

18. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

19. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within

one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

20. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

T. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.

2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.

3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.

4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.

5. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.

6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of ¾ inch.

7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.

8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.

U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548 even if not indicated on Drawings.

END OF SECTION

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.

B. Related Requirements:

1. Division 01: General Requirements

2. Section 21 1313: Fire-Suppression Sprinkler Systems.

3. Section 22 0513: Basic Plumbing Materials and Methods.

4. Section 22 1000: Plumbing.

5. Section 22 2013: Plumbing Piping.

1.02 SUBMITTALS

A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.

B. Submit product data and installation instructions for each item specified.

C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

A. Comply with provisions of:

1. Section 22 0500: Common Work Results for Plumbing.

2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.

3. APWA: Uniform Color Code.

4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.

B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.

C. Bind copies of each chart in operating instructions manual.

D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.

E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.

B. Identify alarm indicating devices and alarm reset devices by nameplates.

C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the “As-Built Drawings”. Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.

B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.

C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
¾ to 1 ¼	8	½
1 ½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
over 10	32	3 ½

D. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).

2. Near each valve and branch connection in such accessible piping.

3. At each pipe passage through wall or floor.

4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.

5. At each change in direction.

E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White
Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water 140ºF	Domestic H.W. 140ºF	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White
Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White

Sump pump discharge	Pump discharge	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White
Fuel oil	Diesel oil	Yellow	Black
Gas	Gas	Yellow	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

1. Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.

   Note (2) words should read “CAUTION: NONPOTABLE WATER DO NOT DRINK.” with international *do not drink* symbol.

   Note (3) words should read “CAUTION: RECLAIMED WATER DO NOT DRINK.” with international *do not drink* symbol.

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.

2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.

3. Detectable marking tape shall be color-coded per APWA Color Code:

   a. Yellow: Oil and gas.

   b. Blue: Water, irrigation and slurry lines.

   c. Green: Sewer and drain lines.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.

B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.

C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

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

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation for plumbing piping.

B. Related Requirements:

1. Division 01: General Requirements.

2. Section 22 0500: Common Work Results for Plumbing.

3. Section 22 0513: Basic Plumbing Materials and Methods.

4. Section 22 0553: Plumbing Identification.

5. Section 22 1000: Plumbing.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.

2. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

6. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

8. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Underwriters Laboratories, Inc.

1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. California Code of Regulation Title 24.

1. California Green Building Standards Code.

1.03 SUBMITTALS

A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.

1. Complete material list of items to be furnished and installed under this Section.

2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.

3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.

4. Display sample cutaway sections.

5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 0500: Common Work Results for Plumbing and Section 22 0513: Basic Plumbing Materials and Methods.

B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and Uniform Mechanical Code and the California Green Building Standards Code.

C. Test Ratings:

1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of

satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.

2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.

3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.

4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.

D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping,

E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.05 PRODUCT HANDLING

A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.

2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

3. Asbestos in any quantity in insulating material is not permitted.

4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:

   a. Nylon anchors for installing insulation to equipment.

   b. Treated wood blocks.

5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Runouts to individual terminal units, not exceeding 12 feet in length.

B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.

D. Insulation Jackets:

1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations.

Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.

2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.

3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.

E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.

F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 DOMESTIC HOT WATER PIPING SYSTEM INSULATION

A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.

B. Materials:

1. Classes of Insulation:

a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.

b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.

c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

LOCATION	CLASS OF INSULATION
Equipment Room	A, B or C
Other Locations	A, B or C

3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.

4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.

B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.

D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.

E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields.

Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.

F. Insulation shall not be installed in the following locations unless otherwise noted:

1. On unions, flanged connections or valve handles.

2 Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or identification of access.

3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.

B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.

1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.

2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.

C. Insulation Jackets in Exposed Indoor Locations:

1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.

2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.

3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.

4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.

D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.

E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with ½-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 CLEANUP

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

3.04 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 22 1000

PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.

B. Related Sections:

1. Division 01 - General Requirements.

2. Section 07 9200: Joint Sealants.

3. Section 10 4413: Fire Extinguishers and Cabinets.

4. Section 11 4013: Food Service Equipment.

5. Section 22 0500: Common Work Results for Plumbing.

6. Section 22 0513: Basic Plumbing Materials and Methods.

7. Section 22 0553: Identification for Plumbing piping and Equipment.

8. Section 22 0700: Plumbing Insulation.

9. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

10. Section 31 2323: Excavation, Backfill for Utilities.

11. Section 33 3000: Site Sanitary Sewer Utilities

1.02 SUBMITTALS

A. Provide in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.

B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.

B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.

C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

1.04 PRODUCT HANDLING

A. Conform to provisions of Section 22 0513: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

A. Materials: Refer to Section 22 0513: Basic Mechanical Materials and Methods.

B. Insulation for Piping: Refer to Section 23 0700: Plumbing Insulation.

2.02 FIXTURES AND DRAINS

A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel, and identified by casting letters "AR" or words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.

B. Finished Brass:

1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.

2. Finished and exposed brass equipment, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.

C. Traps, Trap Arms and Tailpieces:

1. Fixture traps shall be all cast brass, chromium-plated and polished. **(No tubular traps).** Exceptions as follows:

a. Traps that are an integral part of a fixture.

b. Traps concealed in floors, walls and furring.

c. Traps standard for service sinks and Industrial Shop equipment.

d. Laboratory traps and tailpieces shall be as specified in section 22-0700 “Basic Plumbing Materials and Methods”.

2. Concealed traps and 17 gage tailpieces may be rough brass finish, except as otherwise specified. Laboratory traps and tailpieces shall be as specified in Section 22 0700: Basic Plumbing Materials and Methods. Furnish chromium-plated and polished cast brass wall flanges with setscrews and chromium-plated and polished brass casing on discharge side of each trap.

3. Tailpieces shall be not lighter than 17 gage, brass, chromium-plated, and polished. Furnish and install chromium brass plated wall flanges with set screws and chromium-plated 20 gage brass casing on discharge side of each chrome-plated all cast trap.

D. Faucet and Shower Valve Handles: Faucet and shower valve handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished. At accessible fixtures: handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate handles shall be 5 pounds maximum.

E. Fixture Supplies:

1. Supplies for water heaters shall be unplated rigid copper water tube with threaded adaptors for connections to valves and other threaded connections. All other supplies shall be chromium-plated brass with hospital threads or shall be furnished with fittings and valves, which completely cover threads.

2. Exposed supplies for showers shall be chromium-plated brass pipe up to header with hospital threads or shall be furnished with fittings and valves, which completely cover threads.

3. Supplies to water closet tanks, lavatories, and drinking fountains shall be furnished with chromium-plated and polished screwed type angle compression stops with square shank stems and lock shields extending beyond stem. Instead of solid supply piping, polished chrome-plated risers of 3/8 inch outside diameter with ferrule stop end and metal nosepiece may be furnished. The installation of braided stainless or easy hooker's supplies is not permitted. Exception: Supplies that rise vertically from floor shall be furnished with straight type instead of angle type stops.

4. Each supply or pipe that penetrates a finished surface and plumbing pipes passing through a countertop or part of a cabinet shall be furnished with a chromium-plated brass flange except flanges furnished by manufacturer of flush valves as an assembly.

5. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system.

6. Discharge outlets of supply faucets for lavatories and sinks shall clear top of overflow rim by at least one inch.

7. Toilet and urinal flush valves shall be furnished with recognized atmospheric vacuum breakers, installed a minimum of 6 inches above fixture.

2.03 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. Provide for painted and stucco walls.

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462-VP	DW-AKL	MOR DW AK1	CO-300-S-6	UA-A	58650-VP OR EQUAL

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or

polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze. Provide for painted walls, screwed into cleanout plug.

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB	OR EQUAL
4710U	Z-1469-VP	58600	8480R	CO-480-RD-6	C1400-RD-6	

AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured cover with vandal-proof screws. Provide for tile walls.

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM	OR EQUAL
4735U	Z-1460-VP	58630	CO-300-S-6	C1400-S-3-6	58640-VP	

AP-4: Square, floor type, cast nickel-bronze aluminum alloy or brass, with carborundum or scoriated, secured top. Provide for floor access to solid interceptor in Science Room, Ceramic Room, and Agriculture Room.

SMITH	ZURN	JOSAM	WATTS	MIFAB	OR EQUAL
4910U	Z-1461-VP	58630	CO-300-S-6	C1300-S-6	

2.04 CLEANOUT ASSEMBLIES

A. Cleanout plug shall be line size.

B. Schedule Numbers:

CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or ¼ inch No. 20 screws. Provide for finished walls at base of waste stack, above urinal and service sink. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO	

CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal Provide for finished floors inside buildings, in covered areas, and in concrete paving.

Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6	55000-1-SQ	

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1	

CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferule, UPC. Brass approved type plug, scoriated tractor type cover. Provide for areas outside building on concrete paving.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22	

CO-4: Tapped soil tee with brass plug, full line size. Provide for above grade, outside building at base of exposed downspout.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4512	Z-1445-BP	CO-460-34A	C1460	58910	

CO-5: Raised threaded head brass plug. Provide for yard box YB-3.

ZURN	WAATS	SMITH	JOSAM	OR EQUAL
Z-1470-A	CO-590	4285	58540-20	

2.05 DRUM TRAPS

A. Schedule Numbers:

DT-1: Extra heavy cast iron, bolted top.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
8714	ZA1180	SI-742-X	MI-SOLID-S	61030	

DT-2: Aluminum solid interceptor, furnish for on-floor installation.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
8710-AA	Z-1180	SI-742	MI-SOLID-S-AL	61030-26	

2.06 DIELECTRIC UNIONS

A. Schedule Numbers:

1. Dielectric style Unions using ferrous and no-ferrous metals are prohibited. Dielectric flanges are admitted for use – see DU-2.

DU-1: Lead Free Brass union with 6-inch Lead Free Brass nipple.

DU-2: Lead Free Brass union or Lead Free Brass flanged fittings are to be used in between pipes made of dissimilar metals to prevent accelerated corrosion and deterioration in the piping systems due to galvanic and stray current.

WATTS	WILKINS	ZURN	NIBCO	OR EQUAL
LF3100M3			733-LF	

2.07 FAUCETS

A. Access compliant faucets: Force to activate controls shall be no greater than 5 pounds. Self-closing metering, where specified, to remain open 10 seconds minimum when

activated. Handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist.

B. Schedule Numbers: See fixture schedules on plans.

2.08 FLOOR DRAINS

A. Schedule Numbers: See fixture schedules on plans.

2.09 FLEXIBLE HOSES

A. Schedule Numbers:

FLH-1: Braided stainless steel metal hose (for gas use). US Flex, Metraflex, Nelson Dunn or equal.

FLH-2: Braided bronze metal hose (for non-pressure condensate connection use). US Flex, Metraflex, Nelson Dunn or equal.

2.10 HOSE BIBBS

A. Schedule Numbers: See fixture schedules on plans.

2.11 PIPE HANGERS

A. Refer to Section 22 0513: Basic Plumbing Materials and Methods.

B. Schedule Numbers:

1. PH-1: Complete with clamps, inserts, etc.

SUPERSTRUT	UNISTRUT	TOLCO	B-LINE	OR EQUAL

2.12 P-TRAPS

A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

ZURN	AB&A	KOHLER	OR EQUAL
Z-8712-LC	107	K-9018	

2.13 SINKS and TRIM

For classrooms, offices and dining room sinks.

A. Access compliant faucets for sinks: Force to activate controls shall be no greater than 5 pounds. where specified self closing metering to remain open 10 seconds minimum when activated.

B. Cast iron sinks shall be acid resistant enamel, and shall conform to Commercial Standards CS 77.63. Units furnished in conjunction with strainer installation or faucet

installation shall be brass. Exposed brass nuts shall be chrome-plated. Refer to the Fixture Supplies paragraph of this section.

C. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8-inches outside diameter with ferrule stop end and metal nosepiece may be furnished.

D. For access compliant sinks: Insulate cold water, hot water and drain pipes under sinks with district approved type insulation.

PLUMEREX	LAV GUARD	OR EQUAL

E. Schedule Numbers: See fixture schedules on plans.

2.14 SERVICE STOP GAS VALVES

A. Schedule Numbers:

SGV-1: Bronze/Brass gas cock valve with double stake packing nut, ½ inch to 2-inch, with IPS, inclusive, with flat or square head. CSA approved**.** Provide for oven ranges, convection ovens, skillets.

AMERICAN	Mc DONALD	NIBCO	OR EQUAL
85 CBK or 86C	10596, flat 10604, square	GB2A	

2.15 STOP VALVES

A. Stops shall be loose key type, ½-inches IPS inlet and outlet chrome-plated brass casting, except as noted.

B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	CRANE	NIBCO	OR EQUAL
442-LKABCP	8.5113.	77	

STV-2: Partition:

CHICAGO	T& S BRASS	OR EQUAL
1771-ABCP	B-1028	

STV-3: Straight Type, with Loose Key:

CHICAGO	CRANE	T&S BRASS	OR EQUAL
45-LKABCP (1/2 inch)	8-5111	B-O418	

2.16 TRAP PRIMERS

A. Schedule Numbers:

ATP-1: Automatic, multi-trap primer, cast bronze with access panel. Pressure drop of three p.s.i. shall activate trap seal primers. Manufactured by MIFAB, or equal. (Installed in accessible location.)

MIFAB	OR EQUAL
MR-500-NPB	

2.17 WATER TEMPERATURE CONTROLLERS

A. Schedule Numbers:

WTC-1: Remote bulb type, plain steel case, baked enamel finish, glass fronted cover, mercury to mercury switch. 80 degrees F. to 240 degrees F. range of not more than 10 degrees F. differential.

MERCOID	HONEYWELL	JOHNSON CONTROLS	OR EQUAL
DA-4-35	T675A1540	A19 SERIES	

WTC-2: Immersion type, black hard steel case, separate well type, outside adjustment, temperature range 40 degrees to 180 degrees F. range of not more than 10 degrees F. differential.

HONEYWELL	PENN	JOHNSON CONTROLS	OR EQUAL
T-6031D 1007	A19ABC-11	A19 SERIES	

2.18 WATER HAMMER ARRESTORS

WHA-1: Lead Free Water Hammer Arrestor provided for Headers for Lavatories, Wash Sinks, Wash Fountains, Kitchen Sinks, Service Sinks, Urinals and Water Closets. For sizing purposes size according to manufacturer's recommendations.

SIOUX CHIEF	PPP	JR SMITH	WATTS	JOSAM	OR EQUAL
655 and 656 SERIES	SC SERIES	5005 TO 5050 SERIES	Series LF05 and LF15M2	75000	

2.19 YARD BOXES

A. Schedule Numbers:

YB-1 Yard Boxes: 14 ¾-inch by 20-inch by 12-inch, cast concrete, with cast iron traffic cover marked "GAS"

(For use over gas stops).

BROOKS 36-H MB with No. 36-T Cast iron Cover	EISEL 363.5	OR EQUAL

YB-2: Same as YB-1, marked "WATER" **(For use over water valves)**.

BROOKS 36- H MB with No. 36-T Cast iron Cover	EISEL 363.5	OR EQUAL

YB-3: Same as YB-1, marked "SEWER"

BROOKS 36- H MB with No. 36-T Cast iron Cover	EISEL 363.5	OR EQUAL

2.20 FIXTURE CONNECTIONS

A. Branches to individual fixtures shall be of the following sizes (Inches) unless larger sizes are indicated on Drawings:

Fixture	Copper, Cold (Inches)	Copper, Hot (Inches)	Trap and Connections (Inches)	Soil/ Waste (Inches)	Vent (Inches)
Kitchen Sink	1/2	1/2	1-1/2 by 1-1/2	2	1-1/2
Wash Sink	3/4	1/2	1-1/2 by 1-1/2	2	1-1/2
Sillcocks	3/4 minimum	N/A	N/A	N/A	N/A

B. Water headers serving water closets shall be copper water tube, with following size throughout length:

1. 1-1/2 inches for 2 flush valves.

2. 2 inches for 3 to 9 flush valves.

C. Water headers serving urinals shall be of following size throughout length:

1. 1” for 1 or 2 flush valves.

2. 1-1/4” for 3 flush valves.

3. 1-1/2” for 4 to 8 flush valves.

D. Water headers serving showers shall be same as listed above for urinals.

E. Water headers serving lavatories shall be of following size throughout length:

1. 1/2 inch for 2 lavatories.

2. 3/4 inch for 3 and 4 lavatories.

3. One inch for 5 and 6 lavatories.

2.21 HEIGHT OF FIXTURES

A. Heights for standard fixtures.

Fixture	Adult and High	Secondary (Inches)	Elementary (Inches)	Kindergarten and Younger

	School (Inches)			(Inches)
Wash Sinks	30	30	28	24

B. Heights for access compliant fixtures.

Fixture	Adult Ages 12 and Over (Inches)	Elementary Ages 6 to 11 (Inches)	Kindergarten and Younger Ages 3 to 5 (Inches)
Lavatories, sink top height	34 maximum	29 maximum	24 maximum
Lavatories, sink knee clearance	27 minimum	24 minimum	19 minimum
Wash Sink	Per Drawings		

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. General:

1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.

2. Install equipment as indicated on reviewed and accepted Shop Drawings.

3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.

B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.

C. For piping Work, refer to Section 22 0513: Basic Plumbing Materials and Methods.

D. Plumbing Fixture and Equipment Installation:

1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.

2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.

3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing

plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.

4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.

5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be ¼-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two ¼ inch U-bolts per stud with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.

6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be removed at time equipment is set and stops or valves installed and connections provided as specified.

7. Piping materials for trap arms shall be Brass, Cast Iron or DWV copper

8. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.

9. Kitchen equipment requiring backflow protection with hot and cold water connections shall be installed with approved backflow prevention assemblies; BPV-3 and drain into floor sink with air gap.

E. Cleanouts in Drain, Waste, Vent and Sewer Lines:

1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:

   a. At locations above first floor as stated on construction documents and 5 feet outside of the building.

   b Install an accessible main line upper terminal cleanout in all restrooms above water closet over flow. (Install above upper terminal water closet where there are more than one water closet in a restroom).

   c. Above faucets of each sink with brass plug.

d Above service sink with brass plug.

e. At each Drinking Fountain with brass plug.

f. At each urinal and locate above urinal with brass plug.

g. Above overflow level of pot sinks with brass plug.

h. In vertical line at base of each downspout connected to an underground storm drain system extend cleanout to exterior of building.

i. At upper end of a horizontal vent line when any part of horizontal line is below overflow level of fixture it serves.

j. Not to exceed 100-foot intervals in sewer and waste lines exterior of building.

k. At property line connection.

l. Where indicated on Drawings.

2. Cleanouts shall be extended to grade as follows:

a. Not to exceed 100-foot intervals in straight runs of pipe outside buildings.

b. At horizontal changes of direction in aggregate greater than 135 degrees (underground).

c. At property lines.

d. Where cleanouts occur under concrete.

e. Where marked for future connections.

3. Cleanouts in building shall be extended to floor level or above floor level or above floor level in walls or furring when cleanouts are not accessible or where clearance is less than 18 inches.

4. Cleanouts in finished areas in building shall be concealed except that cleanouts above service sinks in janitor's rooms or closet, and cleanouts above service sinks or in exposed piping in boiler or heater equipment rooms, may be exposed. Cleanouts for urinals shall be installed above urinal and shall terminate behind an access plate.

5. Cleanouts in floors of covered areas and those extended to grade in concrete areas shall be floor level type with extensions body brass plugs and detachable nickel-bronze or aluminum alloy scoriated.

6. Concealed cleanouts in vertical lines shall be service weight soil cleanout tees with brass plugs and round cover plates unless otherwise specified or indicated. A snug fitting sleeve of galvanized sheet metal shall be placed around hub of tee and shall extend to flush with finished soil, or cleanout shall be extended to finished wall.

7. Cleanouts extended from below floor to a wall or furring or on horizontal lines above floor that terminate at a wall or furring shall be iron body type with brass plugs and round cover plates.

8. Cover plates over cleanouts in painted walls shall be steel, bonderized and prime coated. Cover plates cover cleanouts in tile walls shall be chromium-plated brass or nickel bronze. Plates shall be attached to cleanout plugs with 5/16 inch No. 18 or 1/4 inch No. 20 stainless steel vandal-proof type screws. Plates shall be one inch larger in diameter than fitting opening.

9. Cleanouts at bases of downspouts shall be tapped soil tees with brass plugs as hereinafter specified, full size of line.

10. Cleanouts extended to grade in exterior sewer lines other than floors or concrete areas shall be a cleanout assembly with secured top, extra heavy-duty, adjustable sleeve, cut-off ferrule, countersunk threaded brass plug and scoriated tractor type cover.

11. Other cleanouts shall be iron body type.

12. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.

13. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.

14. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein and in Section 31 2323: Excavating, Backfilling, and Compacting for Utilities.

3.04 SERVICE CONNECTIONS

A. Determine exact location of required water, drain, and sewer connections and provide proper connections.

B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 WATER HAMMER ARRESTORS

A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):

1. Water lines to lavatory headers, water closet and urinal headers, service sinks, kitchen sinks, wash fountains, drinking fountains, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.

2. Between last two fixtures when three or more fixtures, other than those listed in Number 1 above, are served by a common header.

B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.

C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.06 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line shall not be reduced smaller than unit outlet connection.

B. Condensate drain piping installed within building whether in air conditioned space or not shall be insulated. Refer to Section 22 0700: Plumbing Insulation, for type of material required.

C. Condensate Trap:

1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.

2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.

3. Running trap design is not permitted.

4. Secondary drain shall not be trapped.

D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced, and unit motor running at design condition. Pan shall drain without hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.

E. Secondary Overflow Drain:

1. Drain pan installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.

2 If outside building location is not available or feasible, secondary drains shall be piped to a classroom sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.

3 Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.

3.07 3.07 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into approved drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.08 MAKE-UP WATER SYSTEMS

A. Provide and connect make-up water systems for equipment in other sections.

3.09 GREASE TRAPS (INTERCEPTORS)

A. Grease traps shall be installed only when required by municipal authority. Grease traps shall be separately vented; fixtures connected to grease traps shall be trapped and vented. When grease traps are installed in concrete boxes, fill spaces between grease traps and concrete boxes with sand and place 2 inches of concrete seal over sand. Concrete seals shall pitch toward grease traps with inner edges flush with top of grease traps. Position openings for ease of cleanout.

3.10 GAS SERVICE

A. Above Grade Service: Pipe shall be steel, hammered, free of dirt and scale, and blown out with oil-free air or nitrogen to a clean, dry condition. Piping shall not be installed in or through a ventilation duct or plenum.

B. Underground Service, Gas approved (yellow) Polyethylene Plastic Pipe: Refer to Section 22 0513: “Basic Plumbing Materials and Methods”.

1. Pipes shall be joined with polyethylene fitting and joined together by thermal fusion in accordance with procedures recommended by Polyethylene plastic pipe and fitting manufacturer.

2. Plastic pipe shall be installed not less than 30 inches below grade.

3. Underground Warning Tape shall be installed 12 inches above buried gas piping. Warning tape shall be yellow with caution statement as follows: “CAUTION – BURIED GAS LINE BELOW”.

4. Plastic pipe shall not be installed in or under a building or structure. Pipe shall be installed under bituminous surfacing or compacted soil area, free from large stones. Pipe may be installed under sidewalks or driveways, as long as no joint occurs. Pipe installed under paved covered areas wider than 40 feet shall be installed in ventilated conduits extending 2 feet past paving.

5. Pipe shall be installed on a 6 inches deep sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick.

6. Piping shall not support weight of valves, metal fittings or other items. Pipe shall be installed strain free.

7. Plastic pipe fittings shall not be stored or left exposed to sunlight. Pipe in open trenches shall be shielded. A sand envelope of 6 inches minimum shall be placed around pipe, with exception of joints, until inspection by IOR is completed. Protection for pipe shall be provided when necessary to leave pipe exposed overnight.

8. Installer of piping is required to have training and to have attained a certification. Non-trained/Non-certified installer must contact the manufacturer or manufacturer's representative to provide on-site fusion training and certification, prior to work commencement

9. Polyethylene plastic pipe shall connect to a steel epoxy coated anodeless type riser to minimum of 6 inches above grade, when exiting the underground installation and transitioning to steel pipe connection.

10. Where a steel pipe riser passes into a structure or building, a double swing or double-offset joint shall be furnished. Pipe shall pass into structure 6-inches above grade and through a sleeve with a minimum one inch clearance. An isolation valve is required before pipe entering the building.

3.11 CLEANING - PLUMBING PIPING SYSTEMS AND FIXTURES

A. Plumbing lines and fixtures shall be flushed to remove dirt and foreign material until water runs clear and no foreign substance or odor is present. Strainers and screens on faucets shall be removed during this cleaning operation.

B. After satisfactory cleaning of strainer and screen replacements has been witnessed by the Project Inspector, post and maintain signs stating: "CAUTION - Water at this construction project has not yet been certified for human consumption." Signs shall be furnished with letters at least 1/2 inch in height, and shall be conspicuously posted at entrances to the Project site. Signs shall be paneled, black and yellow, in conformance with OSHA Section 1910.1455.

3.12 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

A. Newly installed or replaced piping and/or fixtures dispensing potable water shall be disinfected and undergo an approved bacteriological analyses before water system is allowed for public use.

B. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II Water Treatment Operator Certification or higher issued by the Department of Health Services (DHS) for the State of California. Comply with Title 22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.

C. Method:

1. A Reduced Pressure Backflow assembly shall be in installed to protect from cross contamination of the local water purveyor's meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.

2. System is to be flushed to remove any materials that may have entered the system.

3. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.

D. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):

1. 24-hour Test Method:

a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, “Water System Being Chlorinated-“Danger Do Not Drink Water” or similar warning.

b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.

c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.

d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.

e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.

f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25 PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.

g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.

h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

2. 3 Hour Test Method:

a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR’s approval.

b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, “Water System Being Chlorinated-“Danger Do Not Drink Water” or similar warning.

c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided

by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.

d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.

e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.

f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

E. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.

2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.

3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.

4. After satisfactory results for the bacteriological test are provided to the OAR, warning sign or tags shall be removed.

F. Drinking Fountain and Bottle Filler Lead Test: After installation of Drinking Fountain or Bottle Filler, and successful Disinfection Test, shut off domestic water supply line feeding the fixture, and inform OAR. OAR will coordinate with the Drinking Water Quality Program (DWQP) Supervisor in local Project Unit and M&O's Plumbing Technical Unit Supervisor to conduct lead detection test, and mitigate as necessary. Do not remove related construction warning sign and tags.

3.13 VALVES ON PLUMBING SYSTEM

A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.

B. Hot and cold valves shall be:

1. Lead free complying with AB1953.

2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.

C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.

1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.

2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.

3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.

4. For classrooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.

5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.

6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.

7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.

8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.

9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:

a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.

b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.

10. Install a lose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,

11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.

12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.

13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.

14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.14 VALVES - GAS SERVICE

A. A gas readily accessible shut-off stop shall be installed on each gas line entering a building immediately prior to the point it enters the building. Unless otherwise specified or indicated, shut-off valves for lines entering a permanent structure, buildings or portable buildings, shall be installed in a vertical riser above grade.

1. Gas shut off valve for portable buildings – A dedicated Gas shut off valve shall be provided in a marked Yard Box, for each portable building to facilitate relocation/removal of building without the need to shut off gas to entire school.

B. Gas Shut off valve within a building – A gas shut off valve with handles shall be accessible and serviceable within an access panel. Install valve minimum 3 feet above floor but less than 7 feet above floor.

C. In addition to locations specified, gas shut off valve shall be installed at following locations:

1. Install a lubricated plug gas shut off valve on any line connected to gas main or header at master assembly.

2. Install a lubricated plug gas shut off valve before entering any building or structure.

3. Install a gas valve on each outlet, in addition to any gas stop furnished with equipment.

4. Service to laboratory gas cocks shall be furnished with a special precision check valve, located downstream from gas stop servicing room outlet at each laboratory cock. Unless otherwise specified, 1/8-inches bore shall be provided for each outlet cock.

5. Install a gas shut-off valve on each gas line serving 2 or more gas outlets in same room. Service stop shall be installed not more than 7 feet above floor, and shall be in the room it serves.

6. Install a gas shut-off valve on inlet side of each gas pressure regulating valve.

7. Gas shut-off valves to be furnished with equipment.

8. Install gas shut-off valve at not more than 1,000 foot intervals on each gas main.

9. At multi-story buildings, provide gas-shut off valve(s) to isolate and control each floor or level. Install valves in a concealed manner in walls with access panels.

10. Gas shut-off valves in classrooms and locations subject to tampering shall be protected while remaining accessible.

D. When a gas-shut off valve adjacent to gas-fired equipment is indicated in Contract Documents it shall be furnished and installed as part of Work of this section.

E. When electrical wall switches with emergency push button are specified for controlling gas outlets at Laboratory Classrooms, provide main shut-off gas valve with normally closed electric solenoid valve within an accessible access panel.

3.15 ELECTROLYSIS PREVENTION

A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:

1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.

2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.

3. Underground dielectric connections shall be furnished in accessible yard boxes.

4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.16 UNDERGROUND PIPE MARKERS

A. Pipe markers shall be furnished according to Section 22 0553: “Plumbing Identification”

B. Under ground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:

1. Yellow – with the words: CAUTION GAS LINE BELOW

2. Blue – with the words: CAUTION WATER LINE BELOW

3.17 HOT WATER CIRCULATING PUMPS

A. Floor-mounted pumps shall be provided with a 4-inch high concrete base with ½ inch reinforcing bars at 12-inch centers each way and doweled into concrete floor.

B. Piping shall be supported from building structure so as to prevent any strain on pump casing.

C. In-line pumps, unless otherwise specified, shall be centrifugal type with non-overloading characteristics and shall not overload motor above its horsepower rating under operating conditions with ratings based on continuous operation.

D. Centrifugal water pumps shall be rated according to Hydraulic Institute Test Code for Centrifugal Pumps. Pumps shall be furnished with bronze water chamber, bronze impeller and mechanical seal. Rotating parts shall be statically and dynamically balanced.

E. Flanged connections shall be provided on pumps with discharge connections larger than 2 inches. Smaller sizes may be threaded connections.

F. Hot water circulating pump shall be arranged so that pump can be automatically turned off when hot water system is not in operation.

3.18 WATER TEMPERATURE CONTROLLERS

A. Furnish and install a water temperature controller in hot water line adjacent to, and for control of, circulating pumps on hot water return lines when said pump is indicated on Drawings or herein specified. Bulb of temperature controller shall be installed so as to be directly in path of flowing water and so as not to obstruct flow of water.

B. Furnish and install a water temperature controller in hot water storage tanks for control of circulating pump on hot water circulating line when said pump is indicated on Drawings or specified herein.

3.19 COMPRESSED AIR SYSTEMS

A. Compressed air systems including compressors, air line filters, receivers, piping and appurtenances shall be installed as indicated and specified.

B. Component parts of compressor unit shall be installed on a base firmly attached to receiver; motor and compressor shall be properly aligned auxiliary equipment and controls specified, furnished with necessary controls, automatic moisture eliminator fittings, piping, conduits and wiring properly installed and connected in a professional manner. Lubricant shall be furnished to fill until ready for operation. Safety valves shall be installed to permit normal operation and properly protect equipment. Thermal units shall be installed in motor starter to trip at 125 percent of motor nameplate rating. Pressure switches shall be installed to cut in and cut out of settings indicated.

C. Compressor shall be installed on vibration dampers and flexible connections installed in piping to isolate vibration. Dampers shall be furnished with transmissibility of less than 10 percent for grade installation and less than 5 percent for above grade floor installation.

D. Furnished compressed air system shall comply with safety orders of Industrial Accident Commission of State of California, Building and Safety Department of City of Los Angeles, and electrical units shall be listed as UL approved. Piping between first downstream moisture eliminator and receiver shall pitch down to receiver and shall be not less than one pipe size larger than pipe leaving eliminator. Provide drip points at each building with piping pitching down to them. Drip leg at each drip point and moisture eliminator shall be not less than 6 inches long, capped 1 ½-inch pipe with drain petcock. Upon completion of compressed air piping installation and prior to testing of pipe and final connection to compressed air receivers, systems shall be blown out to a clean, dry condition.

3.20 DEPTH OF SEWER LINES

A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope ¼ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.21 BACKFLOW PREVENTION DEVICES

A. Backflow Devices: Installation of backflow devices shall be tested and certified by Los Angeles County backflow device tester before Substantial Completion. Tests shall be performed in presence of Project Inspector. Test reports shall be turned over to Project Inspector for mailing to proper agency.

3.22 CLEANUP

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

3.23 PROTECTION

A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 22 11 16H

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

B. Related Requirements:

1. Section 22 11 13 “Facility Water Distribution Piping” for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

2. Division 31 for earth moving.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. System purging and disinfecting activities report.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, 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. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Field Conditions:

1. Pipe shall be transported to the site in enclosed vehicles or with ends covered.

2. Do not store pipe directly on ground or floor.

3. Pipe stored or stacked on site shall be covered.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Domestic Water Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. All materials that come into contact with potable water shall be lead free.

C. All materials specified in this section shall be manufactured in the United States.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B88, Type L water tube, drawn temper.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

C. Copper Unions:

1. MSS SP-123.

2. Cast-copper-alloy, hexagonal-stock body.

3. Ball-and-socket, metal-to-metal seating surfaces.

4. Solder-joint or threaded ends.

D. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.

b. Grinnell Mechanical Products.

c. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B75 copper tube or ASTM B584 bronze castings.

3. Mechanical Couplings for Grooved-End Copper Tubing:

a. Copper-tube dimensions and design similar to AWWA C606.

b. EPDM-rubber gaskets suitable for hot and cold water.

c. Bolts and nuts.

d. Minimum Pressure Rating: 300 psig.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

E. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company.

2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions that match pipe.

3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:

a. AWWA C606 for ductile-iron-pipe dimensions.

b. EPDM-rubber gaskets suitable for hot and cold water.

c. Bolts and nuts.

d. Minimum Pressure Rating:

1) NPS 14 to NPS 18: 250 psig.

2) NPS 20 to NPS 46: 150 psig.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.

2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dresser, Inc.

b. Jay R. Smith Mfg. Co.

c. Romac Industries, Inc.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts; a Watts Water Technologies company.

b. Wilkins.

c. Zurn Industries, LLC.

2. Standard: ASSE 1079.

3. Factory-fabricated, bolted, companion-flange assembly.

4. Pressure Rating: 125 psig minimum at 180 deg F.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples: 6” red brass nipple.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements in Division 31 for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA’s “Copper Tube Handbook.”

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 “Meters and Gages for Plumbing Piping” and with requirements for drain valves and strainers in Section 22 11 19 “Domestic Water Piping Specialties.”

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install shutoff valve immediately upstream and downstream of each water meter.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 “Domestic Water Piping Specialties.”

H. Install domestic water piping at the minimum slopes indicated on drawings.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 “Vibration and Seismic Controls for Plumbing Piping and Equipment.”

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 “Meters and Gages for Plumbing Piping.”

S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 “Domestic Water Pumps.”

T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 “Meters and Gages for Plumbing Piping.”

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 “Sleeves and Sleeve Seals for Plumbing Piping.”

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 “Sleeves and Sleeve Seals for Plumbing Piping.”

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 “Escutcheons for Plumbing Piping.”

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA’s “Copper Tube Handbook,” “Brazed Joints” chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA’s “Copper Tube Handbook.”

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.

2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 4 and Smaller: Use dielectric nipples.

C. Dielectric Fittings for NPS 5 and Larger: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 22 05 48 “Vibration and Seismic Controls for Plumbing Piping and Equipment.”

B. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 “Hangers and Supports for Plumbing Piping and Equipment.”

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.

2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 “Identification for Plumbing Piping and Equipment.”

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in “Piping Tests” Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 2-1/2 and larger shall be one of the following:

1. Hard copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

2. Hard copper tube, ASTM B88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.

4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16H

SECTION 22 11 18H

NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities.
6. Dielectric fittings.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 FIELD CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager & Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. All materials specified in this section shall be manufactured in the United States.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
2. Coating: PE with flame retardant.

    a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

        1) Flame-Spread Index: **25** or less.
        2) Smoke-Developed Index: **50** or less.

3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
4. Striker Plates: Steel, designed to protect tubing from penetrations.
5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig (34.5 kPa).

C. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
    c. Aboveground Portion: PE transition fitting.
    d. Outlet shall be threaded or flanged or suitable for welded connection.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Outlet shall be threaded or flanged or suitable for welded connection.
    c. Bridging sleeve over mechanical coupling.
    d. Factory-connected anode.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm.)

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 125 psig (862 kPa).

E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: [125 psig (862 kPa)]
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.

1. CWP Rating: [125 psig (862 kPa)]
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig (862 kPa).
6. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Valve Boxes:

1. Cast-iron, two-section box.

2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturer: American Meter, Fisher Control Valves, Invensys, Emerson, Maxitrol.Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 5 psig (34.5 kPa).

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Eaton.
   b. Harper Wyman Co.
   c. Maxitrol Company.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.

8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 1 psig (6.9 kPa)

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturer: A.Y. McDonald, Watts, Wilkins, Zurn.
2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: [150 psig (1035 kPa)]
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturer: A.Y. McDonald, Watts, Wilkins, Zurn.
2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: [150 psig (1035 kPa)]
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.2 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.4 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least [36 inches (900 mm)] below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.5 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade 1” per 60 ft.down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).

4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel flat.
    d. Color: Gray

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to **NFPA 54** and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.14 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be **one of** the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be **one of** the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:

1. Annealed-temper, tin-lined copper tube with flared joints and fittings.
2. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
3. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground, branch piping [NPS 1 (DN 25)] Insert pipe size and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
4. Aluminum tube with flared fittings and joints.
5. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.
3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:

1. Bronze plug valve.
2. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:

1. Bronze plug valve.
2. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION 22 11 18H

SECTION 22 11 19H

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Water pressure-reducing valves.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Strainers.
5. Outlet boxes.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water-hammer arrestors.
10. Air vents.
11. Trap-seal primer devices.
12. Flexible connectors.

B. Related Requirements:

1. Section 01 81 13 “Sustainability and LEED Requirements” for sustainability requirements.
2. Section 22 05 19 “Meters and Gauges for Plumbing Piping” for thermometers, pressure gauges, and flow meters in domestic water piping.
3. Section 22 11 16 “Domestic Water Piping”.
4. Section 22 47 13 “Drinking Fountains” for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. LEED Submittal Requirements: Submit for Sustainability Consultant's review.

a. A completed Green Building Material Certification Form (GBMCF), as specified in Section 01 81 13 Information to be supplied for this form shall include:

1) List of all adhesives and sealants installed on the project, within the LEED boundary that were included in the contract.

2) Cost breakdowns for the materials included in the Contractor or sub-contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

3) A total estimated weight (lbs.) value of the material applied within the LEED project boundary.

4) IEQ credit 4, Low Emitting Materials: The VOC content in g/L or applicable certification label for each adhesives, sealants, coatings, paints, etc. per respective LEED requirement.

2. GBMCF Back-Up Documentation: These documents are used to validate the information provided on the GBMCF (except cost data). For each material listed on the GBMCF, provide documentation to certify the material's attributes, as applicable:

a. IEQ credit 4, Low Emitting Materials: VOC content or applicable certification label proof in the form of a cutsheet, MSDS, or letter from the manufacturer.

b. Product cut sheets for materials appearing in the GBMCF. Cut sheets shall be submitted with the Contractor or sub-contractor's stamp, as confirmation that the submitted products are the products installed on the Project.

3. Contractor is required to collect all LEED submittal documentation from the project's subcontractors and assemble into one (1) package per Section or trade, on the GBMCF provided, for review by the Sustainability Consultant. Submit GBMCF and Back-Up Documentation within 30 days of awarded contract. Incomplete or inaccurate LEED submittals may be used as the basis for rejecting the submitted products or assemblies.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

B. All plumbing components including but not limited to valves, strainers, backflow preventers and other wetted parts shall be lead free.

C. Domestic water piping specialties shall be manufactured in the United States.

D. Backflow preventers shall be listed with the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

B. LEED Material Performance

1. IEQ credit 4.1 (IEQc4.1) – Low Emitting Adhesives & Sealants

a. Adhesives, Sealants and Sealant Primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168. Volatile organic compound (VOC) limits listed in the table below correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

b. Aerosol Adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

2. IEQ credit 4.2 (IEQc4.2) – Low Emitting Paints & Coatings

a. ALL associated site-applied adhesives, grouts, finishes and sealers must be compliant with the respective requirements of IEQc4.1, Adhesives & Sealants and IEQc4.2, Paints & Coatings.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts; a Watts Water Technologies company.

b. Conbraco Industries, Inc.

c. Zurn Industries, LLC.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial working pressure of 150 psig.

4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.

5. Valves for Booster Heater Water Supply: Include integral bypass.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

B. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CLA-VAL Automatic Control Valves.

    b. Watts; a Watts Water Technologies company.

    c. Zurn Industries, LLC.

2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.

3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.

4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

    a. Pattern: Globe-valve design.

    b. Trim: Stainless steel.

5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bell & Gossett.

    b. Griswold Controls.

    c. Watts; a Watts Water Technologies company.

2. Type: Ball valve with two readout ports and memory-setting indicator.

3. Body: Brass or bronze.

4. Size: Same as connected piping, but not larger than NPS 2.

5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.

    b. NIBCO INC.

    c. Watts; a Watts Water Technologies company.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.

3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.

b. Milwaukee Valve Company.

c. NIBCO INC.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.

3. Pressure Rating: 400-psig minimum CWP.

4. Size: NPS 2 or smaller.

5. Body: Copper alloy.

6. Port: Standard or full port.

7. Ball: Chrome-plated brass.

8. Seats and Seals: Replaceable.

9. End Connections: Solder joint or threaded.

10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Standard: ASSE 1017.

2. Pressure Rating: 125 psig.

3. Type: Thermostatically controlled, water mixing valve.

4. Material: Bronze body with corrosion-resistant interior components.

5. Connections: Threaded inlets and outlet.

6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

7. Tempered-Water Setting: 105 deg F.

8. Valve Finish: [Chrome plated][Rough bronze].

B. Individual-Fixture, Water Tempering Valves:

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.

2. Pressure Rating: 125 psig minimum unless otherwise indicated.

3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: 105 deg F.

C. Primary Water Tempering Valves:

1. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze.
4. Temperature Control: Manual.
5. Inlets and Outlet: Threaded.
6. Valve Finish: Rough bronze.

2.6 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.7 WATER-HAMMER ARRESTORS

A. Water-Hammer Arrestors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Precision Plumbing Products.

    b. Sioux Chief Manufacturing Company, Inc.

    c. Watts; a Watts Water Technologies company.

    d. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: [Metal bellows][Copper tube with piston].

4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.8 TRAP-SEAL PRIMER DEVICES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MIFAB, Inc.

    b. Precision Plumbing Products.

    c. Zurn Industries, LLC.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig minimum.

4. Body: Bronze.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.

6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Precision Plumbing Products.

    b. Zurn Industries, LLC.

2. Standard: ASSE 1044.

3. Piping: NPS 3/4, ASTM B88, Type L; copper, water tubing.

4. Cabinet: Recessed-mounted steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

6. Vacuum Breaker: ASSE 1001.

7. Size Outlets: NPS 1/2.

2.9 FLEXIBLE CONNECTORS

A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.

2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06.

G. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06.

H. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

I. Install water-hammer arrestors in water piping according to PDI-WH 201.

J. Install air vents at high points of water piping.[Install drain piping and discharge onto floor drain.]

K. Install trap-seal primer devices with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

L. Charge domestic-water expansion tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Division 26.

B. Fire-retardant-treated-wood blocking is specified in Division 26.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Reduced-pressure-principle backflow preventers.

2. Double-check, detector-assembly backflow preventers.

3. Water pressure-reducing valves.

4. Calibrated balancing valves.

5. Primary, thermostatic, water mixing valves.

6. Primary water tempering valves.

7. Manifold, thermostatic, water mixing valves.

8. Outlet boxes.

9. Hose bibbs.

10. Wall hydrants.

11. Trap-seal primer devices.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 “Identification for Plumbing Piping and Equipment.”

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each backflow preventer according to authorities having jurisdiction and the device’s reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19H

SECTION 22 13 16H

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

2. Specialty pipe fittings.

3. Encasement for underground metal piping.

B. Related Requirements:

1. Division 01 for sustainability requirements.

2. Section 22 13 13 “Facility Sanitary Sewers” for sanitary sewerage piping and structures outside the building.

3. Section 22 13 29 “Sanitary Sewerage Pumps” for effluent and sewage pumps.

4. Division 31 for earth moving.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hubless drainage system. Include plans, elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, 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. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. LEED Material Performance

1. IEQ credit 4.1 (IEQc4.1) – Low Emitting Adhesives & Sealants

a. Adhesives, Sealants and Sealant Primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168. Volatile organic compound (VOC) limits listed in the table below correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

b. Aerosol Adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

2. IEQ credit 4.2 (IEQc4.2) – Low Emitting Paints & Coatings

a. ALL associated site-applied adhesives, grouts, finishes and sealers must be compliant with the respective requirements of IEQc4.1, Adhesives & Sealants and IEQc4.2, Paints & Coatings.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

C. Pipe, fittings and couplings shall be manufactured in the United States.

D. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB&I Foundry

2. Charlotte Pipe

3. Tyler Pipe

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A74, Service class.

B. Gaskets: ASTM C564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.

b. Mission Rubber Company, LLC.

c. Tyler Pipe.

2. Standards: ASTM C1277 and ASTM C1540.

3. Description: Stainless-steel shield with four stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A53/A53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Schedule 40, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.

3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Cast-Iron Flanges: ASME B16.1, Class 125.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.

b. Grinnell Mechanical Products.

c. Victaulic Company.

2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A536 ductile-iron castings, ASTM A47/A47M malleable-iron castings, ASTM A234/A234M forged steel fittings, or ASTM A106/A106M steel pipes with dimensions matching ASTM A53/A53M steel pipe, and complying with AWWA C606 for grooved ends.

3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

H. Mechanically formed copper fittings are not permitted.

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Fernco, Inc.

b. Standard: ASTM C1460.

c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Watts; a Watts Water Technologies company.

2) Wilkins.

3) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.

2) Factory-fabricated, bolted, companion-flange assembly.

3) Pressure Rating: 150 psig minimum at 180 deg F.

4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric Nipples: 6” brass nipple.

2.8 PROTECTION FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 “Vibration and Seismic Controls for Plumbing Piping and Equipment.”

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

    1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.

    2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

        a. Straight tees, elbows, and crosses may be used on vent lines.

    3. Do not change direction of flow more than 90 degrees.

    4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    5. Reducing size of waste piping in direction of flow is prohibited.

K. Install soil and waste and vent piping at the minimum slopes indicated on drawings.

L. Install cast-iron soil piping according to CISPI’s “Cast Iron Soil Pipe and Fittings Handbook,” Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings.”

M. Install steel piping according to applicable plumbing code.

N. Install aboveground copper tubing according to CDA’s “Copper Tube Handbook.”

O. Install force mains at elevations indicated.

P. Plumbing Specialties:

    1. Install backwater valves in sanitary waste gravity-flow piping.

        a. Comply with requirements for backwater valves specified in Section 22 13 19 “Sanitary Waste Piping Specialties.”

    2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.

b. Comply with requirements for cleanouts specified in Section 22 13 19 “Sanitary Waste Piping Specialties.”

3. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 22 13 19 “Sanitary Waste Piping Specialties.”

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 22 05 17 “Sleeves and Sleeve Seals for Plumbing Piping.”

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 22 05 17 “Sleeves and Sleeve Seals for Plumbing Piping.”

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 22 05 18 “Escutcheons for Plumbing Piping.”

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.

2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

c. Do not use pipe sections that have cracked or open welds.

D. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

E. Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

F. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.

2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 4 and Smaller: Use dielectric nipples.

3. Dielectric Fittings for NPS 5 and Larger: Use dielectric flanges.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 22 05 23 “General Duty Valves for Plumbing Piping”.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.

2. Install full-port ball valve for piping NPS 2 and smaller.

3. Install butterfly valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 “Vibration and Seismic Controls for Plumbing Piping and Equipment.”

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 “Hangers and Supports for Plumbing Piping and Equipment.”

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

2. Vertical Piping: MSS Type 8 or Type 42, clamps.

3. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

4. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

5. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.

8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.

2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

3. NPS 2-1/2: 108 inches with 1/2-inch rod.

4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

5. NPS 6: 10 feet with 5/8-inch rod.

6. NPS 8: 10 feet with 3/4-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

5. Comply with requirements for cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

6. Equipment: Connect waste piping as indicated.

a. Provide shutoff valve if indicated and union for each connection.

b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.

b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.

c. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.

2. Copper Type DWV tube, copper drainage fittings, and soldered joints.

3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 6 and larger shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.

2. Copper Type DWV tube, copper drainage fittings, and soldered joints.

3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.

3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 13 16H

SECTION 23 00 00H

HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01.

B. The requirements of the General Conditions and Supplementary Conditions.

1.2 SUMMARY

A. Furnish and install a complete (fully tested, adjusted, and ready for operation) mechanical system and fully automatic indoor space thermal conditioning and ventilation (commonly “HVAC”) system with associated controls as described by the Contract Drawings and Specifications.

B. The HVAC systems and design described in the Project documents reflect a building designed for low consumption of energy and water and minimum environmental footprint. Any modifications to the systems described herein shall maintain or improve on the sustainability and energy efficiency features of the project.

C. All design modifications that pertain to system selection, system energy efficiency and energy use, material selection and indoor air quality issues shall require the approval of Integral Group.

D. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

E. Check, verify, and coordinate Work with Contract Drawings and Specifications prepared by all other trades. Include modifications, relocations, and adjustments necessary to complete work or avoid interference with other trades.

F. Where architectural features govern location of Work, refer to Architectural Drawings.

G. Contractor may install additional piping, fittings, and valves, not shown on the drawings, for testing purposes or convenience of installation. Where such materials are installed, they shall comply with the specifications and shall be properly sized for the system and operation. Remove such installed materials when they interfere with design conditions or as directed by the Architect.

H. Commissioning: The scope of work for the Contractor shall not include the duties of the Commissioning Authority (CxA). Contractor will be required, however, to include in their scope of work duties relevant to the commissioning process, including but not limited to training of owner's personnel in the operation of the HVAC equipment, providing manufacturer's startup and pre functional checklists and contractor-provided pre-functional and startup checklists to Commissioning Authority, performing and documenting pre-functional tests for HVAC equipment, performing and documenting functional tests for HVAC equipment, supporting DDC Contractor and Test and Balance Contractor in the performance of their duties, and providing operations and maintenance manuals.

1.3 CODES AND STANDARDS

A. All work and materials shall be in full accordance with the latest local rules and regulations, applicable sections of the California Code of Regulations, Title 24, State Fire Marshal, the Safety Orders of the Division of Industrial Safety, the California Electric Code and applicable State requirements. Nothing in these Plans and Specifications is to be construed to permit work not conforming to these requirements.

B. HVAC system installers shall be trained and certified in the proper installation of HVAC systems including ductwork, pipework, and equipment by a nationally or regionally recognized training or certification program. Uncertified persons may perform HVAC installations when under the direct supervision and responsibility of a person trained and certified to install HVAC systems or a contractor licensed to install HVAC systems.

C. Wherever the Specifications call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these Specifications shall govern. Should there be any direct conflict between the above rules and regulations and the Specifications the rules shall govern.

D. Equipment shall have UL label listing.

1.4 DRAWINGS

A. Layout of the equipment and work is diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. Any interference noted between different drawings, and between drawings and actual field conditions shall be brought to the attention of the Architect and Engineer of Record for a decision. The right is reserved to make any reasonable change in location of equipment without additional expense to the Owner.

B. For purposes of clarity and legibility, drawings are diagrammatic to the extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping and ductwork and locations of equipment shall be governed by structural conditions and obstructions. Contractor shall make use of all data in Contract Drawings and Specifications and field conditions.

C. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, shop drawings of the proposed rearrangement. Because of the diagrammatic nature and small scale of the Contract Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the structural and finish conditions affecting all the Work and shall arrange such work accordingly, furnishing such fittings, equipment, accessories, etc., as may be required to meet such conditions, at no increase in Contract Sum.

D. The construction documents for this project were prepared by the design team using BIM (Building Information Modeling). Using this software by the design team does not relieve the Contractor from performing the necessary coordination to provide complete, code compliant and operational building systems. The plans and sections provided are diagrammatic and show the design intent, these are not intended to be used for fabrication or installation. Contractor is responsible for generating shop drawings for fabrication that meet the design intent as shown on the Contract Documents. The exact location of the piping, ductwork, electrical and support components are to be determined by the Contractor. All building sections and details provided are for information only and do not relieve the Contractor from performing final coordination. Contractor is responsible for coordinating with all other trades.

E. All dimensions and locations of equipment, doors, partitions, etc., are to be taken from the architectural plans but shall be verified at the site.

1.5 MECHANICAL SUBMITTAL PROCEDURES

A. See Division 01 “Administrative Requirements”, for submittal procedures.

B. Mechanical and related submittals are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.

C. For DDC Building Automation Systems, see also SUBMITTALS in Part 1 of Section 25 50 00 for additional submittal requirements and a detailed submittal schedule.

D. Engineer of Record will review submittals and provide comments within the following timeframe after receipt by the Engineer:

1. For typical submittals, allow 10 working days.
2. For large or complex submittals, allow 15 working days. Determination of “large and complex” submittal shall be at the discretion of the Engineer of Record.
3. Do not send Engineer of Record more than 10 submittals in a contiguous period of 5 working days. If excess submittals are received, review period will be extended as necessary to perform proper review. Submittals will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.
4. These submittal review periods supersede and take precedence over periods defined in Division 01, unless Division 01 allows for longer review periods.
5. Submittal review periods shall not be reduced from the times herein except by agreement with the reviewing entity, in advance and in writing.

E. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Use the same identifiers (e.g. equipment tags) used in Contract Drawings.

F. Submittals shall be provided in digital format.

1. Provide a separate file for each submittal. For submittal packages, provide a separate file for each subsection (e.g. hardware cutsheets and shop drawings for the same Section shall be provided as separate files).
2. Product cutsheets, test forms and other text documents shall be provided in word searchable digital format. Acceptable formats are MS Word, PDF (generated from another electronic document and word-searchable; scans of paper documents are not acceptable), and HTML; other formats require approval prior to submission.
3. Drawings and schematics shall be provided in PDF format and in AutoCAD compatible format.
4. Scanned paper documents are not acceptable

    a. Exception: original signed documents, such as qualifications, inspection certificates, and warranty documents.

5. Hardcopy (paper) submittals are not acceptable and shall not be provided except as noted elsewhere).
6. Submittals provided in the wrong format will be returned without action.

G. Submission and Resubmission Procedure

1. Optional Pre-Submittals: At Contractor's option, material may be submitted unofficially via email directly to the Engineer of Record for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time, and to provide a venue to discuss technologies, products, designs or implementation strategies that are novel or unique.
2. Each submittal shall have a unique serial number that includes the associated Specification Section followed by a number for each sub-part of the submittal for that Specification Section, such as SUBMITTAL 230000-01. There is no requirement to assign particular serial numbers to any specific submittals – serial number assignment is arbitrary. The only requirements are that the serial numbers be sequential (to avoid confusing gaps) and, most importantly, consistent across all submittal correspondence.
3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 230000-01 REVISION 1.
4. Submit one copy of submittal in electronic format. Submissions made in the wrong format will be returned without action.
5. Include with each submittal and resubmittal a copy of the relevant specification section(s) noting on each paragraph and sub-paragraph(s) the following:

    a. CONFORMS: Contractor has verified that the submitted product conforms to the noted requirement(s).
    b. CONFORMS AS NOTED: Contractor has verified that the submitted product conforms to the noted requirement(s) by means of being equal to or higher quality and / or performance.
    c. NON-CONFORM: Contractor has verified that the submitted product does not conform to the noted requirement(s) and delineates each deviation from the specification requirements.
    d. NOT APPLICABLE: Contractor has verified that the noted requirement(s), in their opinion do not apply to this product, delineating the reasons for this decision.
    e. Include with each submittal and resubmittal a copy of the relevant specification section(s) the printed name of the contractor reviewer, their signature, the company name, and date of review.

6. Revise submittal

    a. Respond to all comments:

        1) Revise initial submittal to resolve review comments and corrections.
        2) Provide complete responses to comments or suggestions which are not practical to implement in the opinion of the Contractor.

    b. Indicate any changes that have been made other than those requested.
    c. Clearly identify resubmittal by original submittal number and revision number.
    d. Resubmittals that are not responsive to all comments will be returned without action.

7. Resubmit revised submittals until no exceptions are taken.
8. Once submittals are accepted with "No Exceptions Taken" or "Approved As Noted", provide:

    a. Complete submittal of all accepted drawings and products in a single electronic file.
    b. Copies for coordination with other trades, if and as required by the General Contractor or Owner's Representative.

H. Submit shop drawings, a list of proposed material and equipment manufacturers and the names of Subcontractors.

I. Shop drawings shall be provided for all mechanical systems for all floors of the building.

J. Materials and methods with which the words "for approval" or "approved" are used, and materials and methods which differ from those specified, shall be submitted.

K. Prepare and submit shop drawings, sections, details and diagrams to minimum scale 1/4" = 1'-0". Drawings shall be coordinated, dimensioned and indicate equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers, etc. Electronic submittal is encouraged.

L. Submit manufacturer's specifications, product source, data sheets, certified equipment drawings and installation instructions, including installation dimensions, clearances, weights, materials, finishes, color selection, accessories, acoustical characteristics, capacity and full load and part load performance curves; complete with electrical data, motor horse power, KW; motor efficiency, amperage, voltage phases and wiring diagrams. Identify the particular specification section number, paragraph and equipment identification number per equipment schedule. Note that suppliers (wholesalers and distributors) data sheets are not acceptable unless they are also manufacturers of the product being submitted.

M. Fan and pump systems, with equipment in parallel, shall have performance curves noting single equipment operation and all iterations of additional equipment.

N. Certified Equipment Drawings (8-1/2" x 11" sheets) shall be indexed in accordance with Specification Section. Drawings to be submitted at a later date shall be marked with a page as a placeholder for insertion when submitted. The original submittal shall note which shop drawings will be submitted later. Marked-up catalogs are not acceptable and will be returned without action. Electronic submittal is required.

O. Engineer of Record’s review of submittals is for limited purpose of verifying conformance with information given and design concept expressed in Contract Drawings and Specifications. Engineer’s review is not for purpose of determining accuracy or completeness of items such as dimensions and quantities, which remain responsibility of Contractor.

P. Contractor shall not commence with fabrication or installation of any equipment or system until the associated submittals have been approved by the Engineer of Record and returned with “no exceptions” taken. Contractor shall be solely liable for any costs incurred from starting fabrication before approved submittals are returned.

Q. All final approved submittals and equipment datasheets shall be provided, in PDF format, to the owner as part of the as-built drawing set and shall be text searchable.

1.6 COORDINATION DRAWINGS

A. Utilize the latest version of 3D AutoCAD, Navisworks, and/or Revit software for the Coordination Drawings. No proprietary software of any kind shall be used other than that indicated. Drawing paper size shall not be larger than FULL SIZED Contract Drawings, and in no case larger than 30” x 42”. Coordinate available space with ALL other trades involved.

B. Provide Coordination Drawings in digital electronic format. Provide both native file format (AutoCAD, Navisworks, or Revit) and PDF format files. Hardcopy drawings are not acceptable.

C. These drawings are to show registers, grilles, diffusers, duct sizes, elevation of bottom of duct, pipe sizes, valves and accessories, elevation of bottom of pipe, all elevations of materials and/or systems throughout each floor inclusive of hanger components, seismic bracing if applicable, and any component of construction that impacts vertical and/or horizontal space. In addition, the locations of all valves, dampers, and other items requiring access for service and maintenance are to be shown. The drawings are to also show electrical, structural beams, architectural bracing, structural bracing, ceiling heights, access doors, walls, floor to floor dimensions, columns, doors and other major architectural and structural features as shown on the architectural and structural drawings. Where the routing of work differs from that indicated on the Contract Drawings, such areas are to be indicated by highlighting with a note describing the reason for the change.

D. Rerouting of any system or part thereof shall be submitted separately in order to obtain concurrence of the Engineer of Record. Submitted rerouting must include fully documented proposed solutions with all trades coordinated. Contractor is fully responsible for coordination of systems included herein. Any effort by Engineer of Record beyond answering Contractor's questions will be at Contractor's expense, including attending coordination meetings, review of interim plans, or review of incomplete questions (routing issues without suggested solutions).

E. The Contractor and subcontractors are responsible to review and resolve any real or apparent interferences or conflicts as indicated by the coordination drawings produced by each trade.

F. After all conflicts or interferences are resolved, develop a final composite drawing showing the agreed upon routing, layout and juxtaposition of all duct work, conveyers, piping, major conduit, valves, panels, lighting fixtures and all other major mechanical, plumbing and electrical installations. In the preparation of all the final Coordination Drawings, large scale details as well as cross and longitudinal sections are required to fully delineate all conditions.

G. Submit the Coordination Drawings as digital electronic files to Engineer of Record for review and comment, as indicated under “Shop Drawings” above. Coordination Drawings shall be digitally signed-off by all other trades.

H. Contractor shall not commence with fabrication or installation of any equipment or system until the associated shop drawings have been reviewed and returned by the Engineer of Record. Engineer’s review of shop drawings shall not be taken as approval of their contents. Contractor shall be solely liable for any costs incurred due to deviations from the Contract Drawings.

I. No extra compensation will be paid for relocating any duct, pipe, conduit, or other material that has been installed without proper coordination between all trades involved. If any improperly coordinated work, or installed work that is not in accordance with the approved coordination composites, or is specifically noted by the Architect or Engineer of Record for a valid reason, necessitates additional work by the other trades, the costs of all such additional work is to be borne solely by the Contractor.

J. All changes in the scope of work due to revisions formally issued and approved are to be shown on both the individual subcontractor's Shop Drawings and the Coordination Drawings.

1.7 REQUESTS FOR INTERPRETATION AND CLARIFICATION

A. See Division 01 “Project Management”, for RFI procedures and forms.

B. Mechanical RFIs are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.

C. Limit each RFI to a single issue or group of related issues.

D. Each RFI shall include a workable no-cost or lowest cost solution recommendation by Contractor.

E. Allow 3 working days from time of RFI receipt by Engineer of Record for review and response.

F. Do not send Engineer of Record more than 10 RFIs in a contiguous period of 5 working days. If excess RFIs are received, review period will be extended as necessary to provide a professional response. RFIs will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.

1.8 MATERIALS AND SUBSTITUTIONS

A. Comply with Division 01 “Product Requirements”.

B. Requests for product or equipment substitution shall be accompanied by a marked up copy of the Engineer of Record’s original specification. For each specified product feature or requirement, Contractor shall note the equivalent feature or attribute of the proposed substitute product or equipment.

C. Shop drawings of proposed material and equipment that differ from the specified materials and equipment, shall be accompanied by drawings that define changes. These drawings shall show modifications of architectural, plumbing, electrical and mechanical work required by the proposed materials and equipment, such as relocation of flues, drains, revised electrical circuits, relocation of roof or wall penetrations, revised foundations, etc.

1.9 COORDINATION WITH OTHER WORK

A. Contractor performing Work under this Section shall become thoroughly familiar with the Drawings and Specifications. Contractor shall adjust the Work to conform with the conditions shown on these drawings to provide the best possible assembly of the combined Work.

B. Obtain necessary information from the other trades regarding location of their work in order that the Work in this Section may be placed in correct position.

C. The inclusion and proper location of supports, pads, sleepers, openings, anchorages, etc. provided by others is the responsibility of the Contractor under this Section. Cutting and/or boring shall be permitted under this Section only with the written approval of the Architect.

D. It shall be the Contractor's responsibility to coordinate and have provided by other trades where not covered by the Contractor's scope of work, all electrical wiring and power to equipment, controls and devices, and any other work from other trades as required to provide fully functioning HVAC systems per the Contract Drawings and Specifications.

E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no cost impact to the owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.10 MANUFACTURER'S DIRECTIONS

A. Manufacturer's directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Contract Drawings and Specifications.

1.11 PROTECTION OF WORK

A. Equipment and materials shall be stored on dunnage and remain wrapped at all times until installed.

B. Duct and piping shall be remain capped during delivery and storage.

C. During installation, all installed duct and piping shall be capped and protected at the end of each working day.

D. Equipment shall be protected from weather and stored in an enclosed, indoor location.

E. Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

1.12 WORKMANSHIP

A. Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Architect or Engineer of Record, be removed and replaced in a satisfactory manner, without change in Contract Sum or additional cost to the Owner.

1.13 CLOSING IN UNINSPECTED WORK

A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect, Engineer of Record, and/or Commissioning Authority.

B. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the Owner.

1.14 EQUIPMENT ANCHORING

A. Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes.

1.15 PRELIMINARY OPERATION

A. Under this section, Contractor shall supervise and direct preliminary operation of systems should the Owner demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses for such preliminary operation will be paid by the Owner. Such preliminary operation or payment shall not be construed as an acceptance of the work.

1.16 "AS-BUILT" DRAWINGS

A. Comply with Section Division 01 “Project Closeout”.

B. As-built drawings shall be furnished in an electronic format. Provide in drafting software (AutoCAD or Revit) native format and also in PDF format.

1.17 FINAL INSPECTION

A. At the time of final inspection, a service representative shall be available to make final adjustments.

1.18 FINAL OPERATION

A. After acceptance of the installation, instruct the Owner's Representative in operation and maintenance, for a period of three (3), non-consecutive working days at a time requested by the Owner during the first year of warranty.

B. At the beginning of the instruction period, deliver to the Owner three (3) copies of a durable binder as described under "Operating Instructions".

1.19 OPERATING INSTRUCTIONS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these Specifications.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the General Contractor for inclusion in the O&M manuals prior to the training of Owner personnel.

C. Provide a summary of operating sequences (start-up, normal run, and shut-down), and control shop drawings in the main mechanical room.

D. Provide three (3) complete sets of Operating Instructions. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists.

E. Provide a copy of the O&M manuals to the Commissioning Authority for review.

1.20 TRAINING OF OWNER PERSONNEL

A. The General Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The Commissioning Authority (CxA) shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

C. The Mechanical Contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan two weeks before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, air conditioning units, air handling units, fans, boilers, terminal units, controls, water treatment systems, etc.

3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
6. The DDC Contractor shall attend sessions other than the DDC System training, as requested, to discuss the interaction of the DDC System as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
8. Training shall include:

    a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
    c. Discussion of relevant health and safety issues and concerns.
    d. Discussion of warranties and guarantees.
    e. Common troubleshooting problems and solutions.
    f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
    g. Discussion of any peculiarities of equipment installation or operation.
    h. Instruction in the use of equipment controls that are integral to equipment or are provided by the equipment manufacturer, such as VRF System controls. This is in addition to and separate from DDC System training (see below) and does not replace or satisfy the requirement for such training, if specified. Equipment controls training shall include at least the following:

        1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system and any interface with security and communication systems.
        2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
        3) If system supports trending, all trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
        4) Every screen shall be completely discussed, allowing time for questions.
        5) Use of keypad or plug-in laptop computer for mobile control access.
        6) Use of remote access to the system via phone lines or networks, if applicable.
        7) Graphics generation, if applicable.

8) Point database entry and modifications, if applicable

i. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.
j. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate. A video record of the training session is suggested but not required.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
10. The Mechanical Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
11. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

D. Test and Balance (TAB) Contractor. The TAB Contractor shall have the following training responsibilities:

1. TAB Contractor shall meet with facility staff after completion of TAB and instruct them on the following:

a. Go over the final TAB report, explaining the layout and meanings of each data type.
b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
e. Other salient information that may be useful for facility operations, relative to TAB.

1.21 WARRANTY

A. In accordance with Division 01 Project Closeout requirements, Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.

B. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship, or finish.

C. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a minimum period of one (1) year from date of Certificate of Occupancy, or per Division 01, whichever is longer.

D. Warranty also services including instructions, adjusting, testing, noise, balancing, etc.

E. For each piece of equipment or device with a manufacturer's warranty in excess of one year, Contractor shall furnish certificate of manufacturer's warranty and contact information for manufacturer's warranty service. Contractor shall also provide a list or table of all equipment with warranties exceeding one (1) year in duration.

F. Provide new materials, equipment, apparatus, labor and/or service, and support to correct or replace that determined by the Owner to be defective or faulty.

G. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.

H. After a period of 90 calendar days from date of acceptance of systems by Owner, provide, at no cost to the Owner, one service mechanic for an 8-hour period over as many working days as required to repair, replace any latent deficiency.

1.22 SUBMITTALS

A. Welding certificates.

1.23 ACTION SUBMITTALS

A. Product Data: For each type of product in Part 2.

1.24 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

PART 3 - EXECUTION

3.1 CUTTING AND OPENINGS

A. Comply with Division 01 “Cutting and Patching”.

3.2 EQUIPMENT INSTALLATION

A. Install equipment to minimize pressure drop and allow adequate access headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated in drawings (note that in some cases non-parallel installation is indicated in the drawing to reduce pressure drop).

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

END OF SECTION 23 00 00H

SECTION 23 05 13H

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes 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.

B. Related Sections include the following:

1. Section 23 21 23 “Hydronic Pumps”.
2. Section 23 34 00 “HVAC Fans”.
3. Section 26 29 23 “Variable-Frequency Motor Controllers”.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Duty: Continuous duty at ambient temperature of 104 deg°F (40 deg C) and at altitude of 3300 feet (1000 m) above sea level.

C. 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.

D. Motors for submersible pumps shall be hermetically sealed.

E. All motors to have visible nameplate affixed, indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor and efficiency.

F. Minimum Motor Service Factor: 1.15.

2.2 MOTOR ENCLOSURES

A. Totally Enclosed, Fan Cooled (TEFC):

B. Open Drip Proof (ODP)

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficiency, as defined in NEMA MG 1.

C. Polyphase motors shall be suitable for use with Variable-frequency Motor Controllers.

D. Construction:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes to 1600 volts, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Provide motor shaft grounding ring.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Insulation : Class F.

E. Multispeed Motors: Separate winding for each speed.

F. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.4 SINGLE-PHASE MOTORS

A. Single-phase motors larger than 1/20 HP shall be Electronically Commutated (ECM) unless not offered by the manufacturer.

B. Electronically Commutated Motors (ECM)

1. Motor shall be brushless DC type specifically designed for HVAC applications with heavy duty ball bearings and Electronic Commutation. It shall contain internal circuitry that

converts single phase power into a DC signal. Speed control is achieved through a 0-10 volt DC control signal input through the pre-wired controls wires.

2. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.

C. Non-ECM

1. Motors shall be one of the following, to suit starting torque and requirements of specific motor application (listed in order of preference):

   a. Permanent-split capacitor.
   b. Capacitor start, capacitor run.
   c. Capacitor start, inductor run.
   d. Split phase.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

PART 3 - EXECUTION

3.1 APPLICATION

A. All motors installed within the air stream to be Totally Enclosed Fan Cooled (TEFC).

B. All motors installed indoors and out of the air stream to be Totally Enclosed Fan Cooled (TEFC).

C. Motors drawing less than 250 Watts and intended for intermittent service may be standard of equipment manufacturer and need not conform to these specifications.

D. Motors located in hazardous location outside air stream: explosion proof enclosure, hazardous rating.

E. Motors located in hazardous air stream: explosion proof enclosure, hazardous rating.

F. Motors located in wet air streams: totally enclosed wet down.

G. Motors located in exterior locations: totally enclosed wet down.

H. Motors less than 3/4 HP: single phase.

I. Motors equal to or greater than 3/4 HP: polyphase unless stated otherwise.

END OF SECTION 23 05 13H

SECTION 23 05 17H

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 3 inches above finished floor level.

3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at

pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for fire-stopping and fill materials specified in Section 078413 "Penetration Fire-stopping."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves will be considered defective if they do not pass tests and inspections.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls Above Grade: Cast-iron sleeves or Galvanized Steel pipe sleeves.
2. Concrete Slabs Above Grade:

   a. Piping Smaller Than NPS 6: Galvanized Steel pipe sleeves or Sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Galvanized Steel pipe sleeves.

3. Interior Partitions: Galvanized-steel sheet sleeves.

END OF SECTION 23 05 17H

SECTION 23 05 29H

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for 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.

C. All mechanical equipment shall be anchored or braced to meet the horizontal and vertical forces/displacements prescribed in the 2019 CBC and ASCE/SEI 7.

1. The attachment of the following items shall be designed to resist the forces as prescribed above, but need not be detailed on the plans:

    a. Equipment weighing less than 400 pounds supported directly on the floor or roof.
    b. Temporary or movable equipment.
    c. Equipment weighing less than 20 pounds supported by vibration isolators.
    d. Equipment weighing less than 20 pounds suspended from a roof or floor or hung from a wall.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified civil or structural professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

    1. Metal framing systems.
    2. Pipe stands.
    3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

    1. Detail fabrication and assembly of trapeze hangers.
    2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

    1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
    2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
    3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of zinc plated carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper or plastic-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of zinc plated carbon steel.

2.2 THERMAL-HANGER SHIELD INSERTS

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. National Pipe Hanger Corporation.
2. Pipe Shields Inc.
3. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier. For pipes 10-inch diameter and greater Water-repellent treated, ASTM C 533, Type I calcium silicate with 450-psig or minimum compressive strength.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or minimum compressive strength, 450 psig compressive strength on pipes 10-inch diameter and greater.

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.

2.3 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.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. 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.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. 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

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. 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.

D. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. No valve or piece of apparatus shall be used to support the weight of any pipe.

H. Piping shall not be hung from other piping.

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. Piping shall be supported with maximum spacing per 2019 CBC chapter 3, table 313.3.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 10 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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 inch.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in [**Section 099113 "Exterior Painting"**] [**Section 099123 "Interior Painting"**] [**and**] [**Section 099600 "High Performance Coatings."**]

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
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.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. 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: Refer to specification section 23 0529 “Hangers and Supports for HVAC Piping and Equipment”.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use [**powder-actuated fasteners**] [**or**] [**mechanical-expansion anchors**] instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29H

SECTION 23 05 53H

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.

b. Carlton Industries, LP.
c. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to .
6. Minimum Label Size: Length and width vary for required label content, but not less than .
7. Minimum Letter Size: for name of units if viewing distance is less than , for viewing distances up to , and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Pair of Stainless-steel rivets or self-tapping screws. Where equipment is installed in piping utilize a pair of chains.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Maximum Temperature: Able to withstand temperatures up to .

F. Minimum Label Size: Length and width vary for required label content, but not less than .

G. Minimum Letter Size: for name of units if viewing distance is less than , for viewing distances up to , and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Markers for underground piping: 1/8-inch thick, 3” wide, florescent yellow polyethylene tape with imprint to read “Caution – Buried Pipe Below”.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. Self-Adhesive duct Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Maximum Temperature: Able to withstand temperatures up to .

E. Minimum Label Size: Length and width vary for required label content, but not less than .

F. Minimum Letter Size: for name of units if viewing distance is less than , for viewing distances up to , and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 STENCILS

A. Stencils

1. Lettering Size:

Outside Diameter of Insulation or Pipe	Color Field Length	Letter Height
¾ to 1-1/4 inches	8 inches	½ inch
1-1/2 to 2 inches	8 inches	¾ inch
2-1/2 to 2 inches	12 inches	1 ¼ inch
8 to 10 inches	24 inches	2 ½ inch
Over 10 inches	32 inches	3 inches
Ductwork and equipment	---	2 ½ inch

2. Stencil Material: Aluminum.
3. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.6 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. Description: Minimum 1-1/2 inch diameter with letters for piping system abbreviation and numbers.

1. Tag Material: Laminated three layer, double sided, plastic, engraved with black letters on light, contrasting background color, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Corrosion resistant wire-link chain or beaded chain.

C. Valve Schedules: For each piping system, on 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.

2.7 CEILING EQUIPMENT MARKERS

A. Adhesive 10mil vinyl 25mm diameter color ceiling grid marker.

2.8 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately .
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Provide markers on ceiling to locate equipment above T-bar type panel ceiling. Locate in corner of panel closest to equipment. Dots shall be following colors:

1. HVAC dampers, valves and terminal boxes: Blue
2. Plumbing Valves: Green
3. Control Devices and Panels: Red

3.4 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of along each run. Reduce intervals to in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Heating Water Piping: White letters on a safety-green background.
3. Refrigerant Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue with white lettering: For cold-air supply ducts.
2. Yellow with black lettering: For hot-air supply ducts.
3. Green with white lettering: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Stenciled Duct Label Option: Stenciled labels showing, service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of in each space where ducts are exposed or concealed by removable ceiling system. Identify air handling unit number at each location.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

1. On the as-built drawings, indicate the location and number of each tagged valve.
2. Provide a computer file database describing the valve, number, location, type of service normally “open” or “closed”, specific duty of each tagged valve, and manufacturer and model number.
3. Wherever charts, Shop Drawings, etc. Refer to specific room numbers, use room numbers that will be provided by the client rather than the room numbers indicated on the Drawings.

B. Valve-Tag Application Schedule: Tag valves according to color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Colors:

a. Flammable Fluids: Black letters on a safety-yellow background.
b. Combustible Fluids: White letters on a safety-brown background.
c. Potable and Other Water: White letters on a safety-green background.
d. All services not listed above: white letters on a safety-black background

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

B. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters. See Section 3320, Article 7, Subchapter 7, General Industry Safety Orders, Title 8, California Code of Regulations.

END OF SECTION 23 05 53H

SECTION 23 05 93H

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.

2. Testing, Adjusting, and Balancing Equipment:

    a. Fans
    b. Motors.

3. Testing, adjusting, and balancing existing systems and equipment.

4. Sound tests.
5. Vibration tests.
6. Duct leakage tests.
7. Control system verification.

1.3 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. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. Air-Balance Report: Documentation indicating that Work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

2. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. TAB Specialists Qualifications: Certified by [**NEBB**].

1. TAB Field Supervisor: Employee of the TAB specialist and certified by [**NEBB**] [**or**] [**TABB**].
2. TAB Technician: Employee of the TAB specialist and certified by [**NEBB**] [**or**] [**TABB**] as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.8 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:

1. <Insert TAB specialist's name>.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing 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 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 strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.

4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of 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. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and ASHRAE 111 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 233300 "Air Duct Accessories."
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in IP units.

3.5 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 233113 "Metal Ducts."

3.6 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’s Representative 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.

3.7 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 two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit 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 terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit 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 terminal units.
    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. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
g. 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 terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit 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, relief and return fans.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. 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.

3.10 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at following locations:

1. Xxx
2. Xxx
3. Xxx
4. etc

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 night in 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 than36 inches a wall or from the operating equipment and approximately 60 inches 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.

3.11 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 10.

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.

3.12 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.

3.13 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.

3.14 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.

3.15 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Relief, Return, and Exhaust Fans and Equipment with Fans: [**Plus or minus 10 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.

3.16 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 biweekly 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.

3.17 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 terminal units, 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. Terminal units.
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.

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. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.
    j. Entering-water temperature in deg F.
    k. Leaving-water temperature in deg F.

    l. Refrigerant expansion valve and refrigerant types.

m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

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. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.18 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner’s Representative.

B. Owner’s representative 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’s representative may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.19 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 23 05 93H

SECTION 23 07 13H

HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Duct insulation.
2. Insulation jackets.

B. Related Sections:

1. Division 01 - Volatile Organic Compound (VOC) Content Restrictions.
2. Division 07 - Firestopping.
3. Division 09 - Painting and Coating: Painting insulation jackets.
4. Section 23 05 53 - Identification for HVAC Piping and Equipment.
5. Section 23 31 00 – HVAC Metal Ducts

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

D. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).

G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.

H. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2013.

L. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 ACTION SUBMITTALS

A. See Division 01 and Section 23 00 00 “HVAC General Requirements” for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved. Include details for removable insulation sections at access panels.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

Retain paragraph below if Contractor is responsible for field quality-control testing and inspecting.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum five (5) years of experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping. Any insulation subjected to moisture shall not be used.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Requirements for all products of this section:

1. Surface Burning Characteristics:

a. Indoor insulation: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
b. Outdoor insulation: Flame spread/Smoke developed index of 75/150, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.

2. Products shall not contain PVC, asbestos, lead, mercury, or mercury compounds.
3. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Mineral Glass fiber, flexible:

1. Manufacturer:

a. Knauf Insulation.
b. Johns Manville Corporation.
c. Owens Corning Corporation.
d. CertainTeed Corporation.

2. Insulation: ASTM C553; flexible, noncombustible blanket with a thermosetting resin, Type II with factory applied FSK jacket.

Wrap thickness is typically 1.5 inch up to 3 inch. Denser insulation will have better thermal performance. Remove densities not needed, differentiate in schedule in Part III. K-values are uncompressed values.

a. Density / Thermal Conductivity ('K' value):

1) 0.75 pcf / K = 0.29 at 75 degrees F, when tested in accordance with ASTM C518.

2) 1.0 pcf / K = 0.0.27 at 75 degrees F, when tested in accordance with ASTM C518.
3) 1.5 pcf / K = 0..24 at 75 degrees F, when tested in accordance with ASTM C518.

b. Maximum Service Temperature: 250 degrees F, tested by ASTM C 411.
c. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Mineral Glass fiber, rigid:

1. Manufacturer:

a. Knauf Insulation.
b. Johns Manville Corporation.
c. Owens Corning Corp.
d. CertainTeed Corporation.

Board thickness is typically 1.5 inch up to 3 inch. Denser insulation will have better thermal performance. Remove densities not needed, differentiate in schedule in Part III.

2. Insulation: ASTM C612; rigid, noncombustible board.

a. Density / Thermal Conductivity ('K' value):

1) 1.6 pcf / K = 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2) 3.0 pcf / K = 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
3) 6.0 pcf / K = 0.22 at 75 degrees F, when tested in accordance with ASTM C518.

b. Maximum service temperature: 450 degrees F.
c. Maximum Water Vapor Sorption: 5.0 percent.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 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 Construction Products.
   c. Knauf Insulation.
   d. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 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.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches (75 mm).
2. Thickness: 6.5 mils (0.16 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches (50 mm).
2. Thickness: 6 mils (0.15 mm).
3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

a. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
b. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.7 FIELD APPLIED JACKETS

A. Aluminum Jacket (Alum): ASTM B209 (ASTM B209M).

1. Thickness: 0.016 inch sheet.
2. Finish: Stucco embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
6. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
7.

B. Aluminum Outdoor Jacket (Alum Outdoor).

1. 60-mil- (1.5-mm-) Composite membrane consisting of a multi-ply embossed aluminum foil/polymer laminate and rubberized asphalt.
2. UV-resistant.

2.8 SECUREMENTS

A. Bands:

Wing seals are primarily used for fastening bands together.

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, [**Type 304**] [**or**] [**Type 316**]; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with [**wing seal**].

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that ducts have been pressure tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Install in accordance with manufacturer's instructions.

C. Install in accordance with NAIMA National Insulation Standards.

D. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and/or bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

K. Apply insulation with the least number of joints practical.

L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Where service access is required, provide removable insulation sections that allow for removal and replacement without damaging surrounding insulation. At nameplates, bevel and seal ends of insulation.Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

M. Hangar Inserts.

1. For support points of rectangular or oval ducts supported by trapeze hangers, place weight supporting insulation at bottom of duct over trapeze. Weight supporting insulation shall be rigid glass fiber insulation having minimum of 6 pcf density and 200 lb/ft compression strength at 10% deformation and minimum 6" long with same thickness as insulation specified. Weight supporting inserts similar to HAMFAB H-block by ICA Inc. may be used for rectangular ducts less than 18". Follow manufacturer's recommendation for number of inserts.
2. For support points of round ducts smaller than 16" diameter, weight supporting insulation is not required for either rigid or flexible glass fiber insulation.
3. For support points of round ducts 16" diameter and larger, place weight supporting insulation between duct and strap or trapeze.
4. Flexible glass fiber insulation may be installed outside of support for round ducts 24" diameter or smaller, provided vapor barrier integrity is maintained at rod / strap penetration.
5. 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.

N. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

O. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) 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.

P. Cut and install insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Q. External Duct Insulation Application:

1. Secure insulation with vapor barrier and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples or tape.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.3 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 (50 mm) 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 (50 mm).
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 (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping"irestopping and fire-resistive joint sealers.

3.4 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 or as recommended by insulation manufacturer.
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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not compress insulation more than 75% 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces or as recommended by insulation manufacturer..
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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.5 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.6 FIELD QUALITY CONTROL

A. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [**one**] location(s) for each duct system.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 SCHEDULES

A. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.
6. Return air ducts in conditioned space
7. Transfer air ducts.

B. Location definitions:

1. Concealed: ductwork in ceilings and shafts.
2. Exposed: ductwork that is not concealed, but also not in occupied spaces such as ductwork in mechanical rooms.
3. Occupied: ductwork in occupied and conditioned rooms.

Revise table to suit project. Outside air in exposed locations is only required where exterior design temperatures are below 35 deg F. Add rows for special cases.

3.8 Table: DUCT INSULATION

Type	Location	Insulation	Minimum Thickness	Jacket
Supply/Return	Outdoor	Fiber Board 6.0pcf	2.0 inch	Alum Outdoor
		Fiber Wrap 1.5pcf	3.0 inch	
	Concealed	Fiber Board 1.6pcf	1.5 inch	None
		Fiber Wrap 0.75pcf	1.5 inch	

END OF SECTION 23 07 13H

SECTION 23 07 19H

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Steam piping, indoors and outdoors.
3. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

3. Product Data: For coatings, indicating VOC content.

4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

5. Product Data: For sealants, indicating VOC content.

6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 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.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 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.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Ramco Insulation, Inc.
    b. Industrial Insulation Group.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. K-Flex USA.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. 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. Foster Brand; H. B. Fuller Construction Products.

2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.

2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Speedline Corporation.

2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. VOC Content: 300 g/L or less.
2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Barrier Mastic: Water based; suitable for indoor 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 Construction Products.
c. Knauf Insulation.
d. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

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 Construction Products.
c. Vimasco Corporation.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
5. Service Temperature Range: 0 to plus 180 deg F.
6. Color: White.

2.6 SEALANTS

A. 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.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

6. Sealant shall have a VOC content of 420 g/L or less.

7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

6. Sealant shall have a VOC content of 420 g/L or less.

7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Airex Manufacturing.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: [**White**] [**Color-code jackets based on system. Color as selected by Architect**].
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.

4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Compac Corporation.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Venture Tape.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

e. Venture Tape.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 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.
b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. For additional requirements for installation on chilled water refer to NAIMA “Guide to Insulating Chilled Water Piping Systems with Mineral Wool Insulation”.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints. On outdoor jackets longitudinal joints shall be located on underside of pipe..

3.9 FINISHES

A. Pipe Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 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. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Steam and Steam Condensate:

1. NPS 1 and below and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

2. NPS 1-1/2 to NPS 3: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

C. Refrigerant Suction and Liquid Piping:

1. NPS 3/4 and smaller: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

2. NPS 1 and larger: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Steam and Steam Condensate:

1. NPS 1 and below and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

2. NPS 1-1/2 to NPS 3 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

B. Refrigerant Suction and Liquid Piping:

1. NPS 3/4 and smaller: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

2. NPS 1 and larger: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION 23 07 19H

SECTION 23 08 00H

COMMISSIONING OF HVAC AND PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of this section is to specify Division 22 and 23 responsibilities in the commissioning process which are being directed by the Commissioning Authority (CxA). The commissioning requirements designated in this section pertain to building commissioning activities and documentation in support of Calgreen Commissioning Requirements.

B. The systems to be commissioned are listed in Division 01 “General Commissioning Requirements”. Contractors MUST refer to Division 01 for this and other Commissioning information. Mechanical and Plumbing Systems Commissioning section does not replace, but instead complements, the contents of the Division 01 section and all parties shall be held to the information contained in both sections.

C. Commissioning (Cx) requires the participation of Division 22 and 23 to ensure that all systems are operating in a manner consistent with the Contract Documents through documented functional testing and startup procedures. The general commissioning requirements and coordination are detailed in Division 01. Division 22 and 23 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Commissioning Authority (CA) and shall execute all Cx responsibilities assigned to them in the Contract Documents.

1.2 RELATED SECTIONS

A. Division 01 “General Commissioning Requirements”.

B. Section 25 50 00 “Building Automation System Hardware and Networking”.

1.3 DEFINITIONS

A. A/E: Architect / Engineer.

B. BIM: Building Information Management.

C. CAD: Computer Aided Design.

D. CM/GC: Construction Manager / General Contractor.

E. Cx: Commissioning.

F. CxA: Commissioning Authority.

G. CxC: CM/GC Commissioning Coordinator.

H. FPT: Functional Performance Test(ing).

I. HVAC: Heating, Ventilating, and Air Conditioning.

J. I/O: Input / Output.

K. O&M: Operations and Maintenance.

L. P/T: Pete's Plug.

M. TAB: Testing and Balancing.

1.4 RESPONSIBILITIES

A. MECHANICAL, PLUMBING, CONTROLS, and TAB CONTRACTORS. The Cx responsibilities applicable to each of the mechanical, plumbing, controls and TAB contractors of Division 22 and 23 are as follows (all references apply to commissioned equipment only):

1. Include and itemize the cost of Cx, including functional testing, documentation, and all specified requirements in the contract price.
2. In each purchase order or subcontract written, include requirements for submittal data, Cx documentation, O&M data and operator training.
3. Attend a Cx scoping meeting and other meetings necessary to facilitate the Cx process.
4. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.
5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of functional testing procedures.
6. This shall include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, fan and pump curves, preliminary balance reports, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
7. The CxA may request further documentation necessary for the commissioning process, and requests may be made prior to normal submittals.
8. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.
9. 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.
10. Provide assistance to the CxA in preparing the specific functional performance test procedures. Contractors shall review test procedures to ensure feasibility, safety, acceptability under warranty requirements, equipment protection, and provide necessary written alarm limits to be used during the tests.
11. During the startup and initial checkout process, execute the pre-functional checklists (provided by CxA) for all commissioned equipment and return to the CxA.
12. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA for inclusion in the Commissioning Report. This may be done parallel with the pre-functional tests.
13. Address current Architect / Engineer (A/E) punch list items before the commencement of functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
14. Provide skilled technicians to execute starting of equipment and to rehearse and execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and all resultant problem-solving.

15. Provide skilled technicians to perform functional performance testing under the direction of the CxA for specified equipment. Contractor shall rehearse the functional tests and correct system (or identified and informed the CxA of test procedure) discrepancies from design prior to the verification tests. Assist the CxA in interpreting the monitoring data, as necessary.
16. Provide written responses, in a timely manner, to all items noted in the Cx submittal reviews and Cx issues log that relate to Division 22 and 23.
17. Correct any deficiencies (differences between specified and observed performance) as interpreted by the CxA, Construction Manager / General Contractor (CM/GC) and A/E and retest the equipment. Note contractor may be responsible for the cost of retesting if there are excessive test failures; see Division 01.
18. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
19. During construction, maintain as-built red-line drawings for all drawings and final CAD as-built for contractor-generated coordination drawings. Provide to CxA as requested for functional test development and update after completion of commissioning (excluding deferred testing and seasonal testing).
20. Provide training of the Owner's operating staff using expert qualified personnel, as specified in Division 01.
21. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
22. Warranty Period

    a. Assist CxA in execution of select seasonal or deferred functional performance testing.
    b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. MECHANICAL CONTRACTOR. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed are:

1. Provide startup for all HVAC equipment.
2. Assist and cooperate with the TAB contractor and CxA by:

    a. Review Draft Functional Performance Tests and issue comments to CxA.
    b. Successfully rehearse Functional Performance Tests and provide a signed copy prior to CxA visit to witness test execution.
    c. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and Cx, as required.
    d. Including cost of sheaves and belts that may be required by TAB.
    e. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide approved plugs to seal holes.
    f. Providing temperature and pressure taps according to the Construction Documents for TAB and Cx testing. Note sample port (P/T or Pete's plug) requirements in hydronic details.
    g. Install a P/T plug at each water sensor which is an input point to the control system.
    h. List and clearly identify on the as-built drawings the locations of all air-flow stations.
    i. Prepare a preliminary schedule for Division 22 and 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.
    j. Notify the CxC or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the CM/GC Commissioning Coordinator or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed

and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

k. Verify all air is bled from system and verify bleed by checking for air at 10% of manual vents no more than 3 days prior to functional testing.

C. CONTROLS CONTRACTOR. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed are:

1. As-Built Sequence of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, including time of day schedules, schedule frequency, and detailed point listings with ranges and initial setpoints.
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

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls as-built drawings submittal.
4. Assist and cooperate with the 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 contractor any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
    b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
    c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
    d. Coordinate with the TAB contractor to acquire all balance related setpoint, for example the minimum duct pressure required at design flow and/or the pump system pressure differential required at design flow condition.

5. Assist and cooperate with the CxA in the following manner:

    a. Review Draft Functional Performance Tests and issue comments to CxA.
    b. Successfully rehearse Functional Performance Tests and provide a signed copy prior to CxA visit to witness test execution.
    c. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system. Assist the CxA in interpreting the monitoring data, as necessary.
    d. Execute all control system trend logs specified in Functional Tests. Trend data will be required in electronic format, specifically in a Microsoft Excel compatible format (ASCII text, comma delineated,.xls, etc.).
    e. Ensure that all of the trended points are sampled at 1 minute intervals, all points may be trended simultaneously and the data is stored for all points at minimum for a 1 year period.

f. Provide the Commissioning Authority remote internet access to the Building Automation System during the Commissioning Period.

6. Provide a signed and dated certification to the CxA and CM/GC Commissioning Coordinator 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 Contract Documents, except functional testing requirements.
7. 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).

D. TAB CONTRACTOR. The duties of the TAB contractor, in addition to those listed are:

1. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CxA and CxC at least once a week.
2. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
3. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CxA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB, or ASHRAE Standard 111.
4. Demonstrate repeatability of 10% of final air and water measurements, upon request by CxA.
5. Provide the CxA with any requested data, gathered, but not shown on the draft reports.
6. Provide a final TAB report for the CxA with details, as in the draft.
7. Assist in resolving any balancing issues discovered during functional testing.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division. Refer to Division 01.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS AND PROCEDURES

A. Refer to Division 01 “General Commissioning Requirements” for a summary of the Commissioning process and procedures.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this specification. Division 22 and 23 contractors 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 do not relieve or lessen this responsibility or shift that responsibility partially to the CxA or Owner.

B. Review and Complete Pre-functional Checklists in accordance with Division 01.

C. CM/GC Commissioning Coordinator (CxC) shall verify completion of all items, sign and return the checklist to the Commissioning Authority as an indication of final completion with all installation criteria as specified in the Project Contract Documents

D. A separate completed checklist shall be submitted for each system and item of equipment within the commissioning scope of work, as specified in Division 01.

E. The Pre-Functional Readiness Checklists do not represent all the contract documents for the associated equipment. Completion of the items on this checklist does not release the contractor from requirements specified elsewhere.

3.3 TAB REVIEW

A. Testing, Adjusting and Balancing (TAB): TAB shall be provided by the Contractor in accordance with the project specifications. The TAB contractor shall support commissioning by submitting the preliminary TAB data for CxA review and participating on the Commissioning TAB Field Review, in which the TAB Contractor demonstrates specified results to the CxA after completion of final TAB.

B. Equipment tested: All HVAC systems & associated equipment.

C. Demonstrate:

1. Determination of the final set points for pump speed and fan speed control per the project specifications. Demonstrate for all set points.
2. Airflow rates are balanced and adjusted per the project specifications.

    a. Demonstrate minimum outside airflow rates for all air handling equipment.
    b. Demonstrate a 10% sample for all other measurements.

3. Hydronic system flow rates are balanced and adjusted per the project specifications.

    a. Demonstrate for all boilers, chillers, cooling towers, and distribution pumps.
    b. Demonstrate a 10% sample for all other measurements.

4. Verify TAB of circulating domestic hot water system per the project specifications. Demonstrate a 10% sample.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. The Functional Performance Test (FPT) Procedures shall be developed, performed, and demonstrated in accordance with Division 01.

B. Contractor is responsible for conducting test runs of all required Functional Performance Tests, and submitting results to the CxA prior to the Commissioning Authority witnessed Functional Testing. See Division 01 for additional details.

C. The initial FPTs shall be provided after review of the final and approved controls submittal. The final FPTs may be modifications of the initial FPTs, and FPTs may be added; modifications and

additions to be made by the Commissioning Authority after equipment submittals have been accepted.

D. The Contractor's Commissioning Coordinator shall coordinate the subcontractors, with the Commissioning Authority's input, in developing, performing, and demonstrating the Working FPT.

E. Functional testing shall consist of the following four phases:

1. Component testing:

    a. Component testing applies to all control input and output devices, including those provided by the equipment suppliers and those provided with the Building Automation System (BAS). Examples include but are not limited to: sensor assemblies, detectors, relays and switches, valves, dampers, and actuators
    b. Component testing applies to thermometers, gauges:
    c. Component testing consists of demonstrating field I/O calibration and operation including but not limited to:

        1) Accuracy of sensors is within design temperature range as specified.
        2) Alarmed points report correctly to operator work station.
        3) Accuracy and settings of binary switches and alarms is as specified, within design temperature range
        4) Actuators operate smoothly in a linear relationship with the signal they receive over the full range of operation
        5) Fail safe operation of components and controllers is as specified for loss of control signal, electric power, and network communications
        6) All components, values and alarms are correctly mapped to operator interface station
        7) Air pressure reference points appropriately located and protected from transient effects of diffusers, wind, and other localized conditions.

2. Systems Testing; Operational Verification: After functional testing of the system components has been successfully completed, each sequence of operation and control system function shall be functionally tested, including those provided by the equipment suppliers and those provided with the Building Automation System (BAS). Each control loop shall be tested to verify stable control with the specified and appropriate responses. Testing may include examination of trended data for any point, even where not explicitly called out in functional test script.
3. Systems Testing - Integrated System Verification: After operational testing has successfully demonstrated that each system functions in accordance with the project documents, functional testing shall occur to verify that the interaction between the systems is as required. Each interactive function shall be functionally tested, including those provided by the equipment suppliers and those provided with the BAS.
4. Systems Testing - Real Time Performance Analysis (trend logging):

    a. After operational testing has been successfully completed real time performance testing may be performed to further corroborate correct operation and/or verify the operation of systems that eluded the initial test phase. Data shall be logged for the intervals and periods specified in the FPT procedures. Unless otherwise specified in the FPTs, test periods shall include occupied, unoccupied, weekday and weekend schedules.
    b. All points shall be trended, initiated at the end of construction, continuing over the entire commissioning period and left in place for future use or seasonal commissioning. All points shall be simultaneously trended per the interval specified

by the CxA. Historical archiving shall be enabled so that data is continuous with no gaps and accessible in the future. The data shall be capable of being stored at a minimum of 1 year period.

c. Internet or web-based remote access shall be provided to the commissioning agent for the commissioning period. Trends shall be displayed graphically and shall be user configurable at the graphical interface. Graphical displays shall be capable of containing multiple points on a single graph.

d. Analysis of the data shall demonstrate that that the systems operate in accordance with the acceptance criteria specified in the FPT procedures. Verify that data demonstrates acceptable results before submitting for CxA review. If acceptable results are not demonstrated, perform testing and trouble shooting and corrective action to provide resolution. Provisions for retesting, as specified in Division 01 shall apply to trend log analysis.

e. In addition to the initial test period, data logged during a peak heating period, a peak cooling period, and a transitional season period if so specified.

3.5 ISSUE CORRECTION

A. See Division 01 “General Commissioning Requirements”.

3.6 OPERATION AND MAINTENANCE (O&M) MANUALS

A. See Division 01 “General Commissioning Requirements”.

3.7 TRAINING OF OWNER PERSONNEL

A. See Division 01 “General Commissioning Requirements”.

END OF SECTION 23 08 00H

SECTION 23 09 45H

SYSTEM CLOUD BASED CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. The following provides the basic and minimum specifications and requirements for an open system Cloud-Based HVAC Monitoring and Controls (CBMC) project in accordance with the accompanying plans.

B. Functionality delivered from the CBMC shall include, but not limited to:

1. Integrate with building environmental systems and third party applications via an open and documented interface
2. Provide system alarms and analytics for building environmental management and notification
3. Gather and store instantaneous and historic trend data that is consistent across multi-vendor systems
4. Utilize web & mobile applications for improved serviceability

1.2 Hardware and software coordinated with equipment manufacturers
1. Third party APIs
2. Data formats or protocol specifications
3. Equipment interface hardware

1.3 SYSTEM DESCRIPTION
1. Provide a complete CBMC system consisting of, but not limited to building management system. The system shall meet all of the performance requirements as shown on drawings and as outlined in this and related sections of the specifications.
2. Mechanical systems are equipped with manufacturer furnished controls and shall be interfaced with the CBMC system via hardware. All labor, materials, equipment, software, and services necessary for the installation of a complete integrated system shall be provided.
3. Equipment and labor not specifically referenced or on the drawings shall be required to meet the functional intent, and shall be provided without additional cost to the Owner.

1.4 SUBMITTALS

A. Project Management

1. The Installing Contractor or Equipment Supplier shall act as Project Manager to coordinate the work of the following parties:

a. Equipment Manufacturer

b. Equipment Supplier

c. Installing Contractor

2. The Project Manager shall ensure the appropriate parties provide engineered drawings, control sequences, bill of materials, project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents, and shall indicate timing and dates for system installation, debugging, and commissioning.

B. Drawings

1. The Equipment Supplier shall submit engineered drawings using control sequences provided by Engineering Design Firm.

2. Drawings shall be submitted as digital PDF or AutoCAD compatible format for printing in the following standard sizes: 11” x 17” (ANSI B).

3. Drawings shall be available on web-based document storage site.

C. System Documentation

Include the following in submittal package:

1. All input/output object listings and an alarm point summary listing.

2. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.

3. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.

1.5 COMMISSIONING

A. Start-up Commissioning

1. The CBMC shall be available to assist with start-up commissioning. This shall include the ability to verify system data remotely and generate a commissioning report.

B. Monitoring Based Commissioning (MBCX) System Commissioning Definition:

1. The CBMC shall qualify as a monitoring based commissioning tool (MBCX) without the need for additional software, A monitoring or ongoing commissioning program allows for continuous performance monitoring of equipment for the purpose of identifying and diagnosing issues such as energy waste or equipment malfunctions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Riptide IO, Inc.

2. Or equal

2.2 System Overview: An open system architecture means each HVAC component (devices or applications) should work together and deliver its specified level of performance with no loss. The following three layers are required:

A. Cloud Layer: Cloud computing architecture.

B. Application and Services: A web and mobile phone applications for operating, monitoring and controlling the system.

2.3 CLOUD LAYER

A. General: The System shall employ modern cloud applications designed for IoT and big data technologies. It shall be open at the cloud layer allowing for interaction with other cloud application via published APIs to support integration with other business application.

B. System management. The system shall have the ability to perform software updates in an automated fashion over the network. This includes updates of the master building controller Operating Systems and the application software loaded onto the master building controller. All updates should support a current form of digital signing to ensure the integrity of the software package.

C. Connectivity management. The solution should have the ability to detect communication failures both at the gateway level and downstream of the gateway.

D. Data collection, processing & management.

1. The system shall leverage a noSQL or equivalent distributed database. No additional database licenses shall be required.

2. Administrators and credentialed users shall be provided means to export customized data reports.

3. There shall be no limitation on the amount of data points stored over time.

4. Advanced analytics capabilities (AI & Machine learning, logic programming UI) shall be available.

2.4 APPLICATION LAYER

A. Web and mobile application: Web applications shall be HTML5, web browser-based and not require plug-ins. Mobile applications shall be native Apple iOS and Google Android, available for download at the respective app stores.

B. Monitor and Control: Application shall provide the ability to monitor and control the HVAC units and systems.

C. Notifications: Application shall provide the ability to send notifications via email and text and configure various escalations.

D. Canned and custom reporting: Application shall include a set of canned, existing reports and also allow for the user to create custom reports. Ad hoc trend graphing for all equipment and points shall be available.

E. Analytics. It shall be capable of performing advanced analytics and contain a library of fault detection and diagnostic algorithms specifically designed for HVAC systems.

F. Schedules: Application shall be able to view and adjust scheduled operating hours of each individual, schedulable piece of equipment on a weekly schedule display. Application shall be able to view and adjust exception schedules/holiday schedules on the schedule display. Application shall be able to create schedule groups and group like equipment schedules.

G. Graphics: Operator interface shall be accessible utilizing standard and supported web browser software. The graphical interface will display building locations on a geographic map, allowing for dynamic scaling. The equipment graphics user interface shall allow the operator to view system status and update control points for the most important data for each zone. A notification user interface shall allow for response to alarms and faults. Application shall include graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system.

H. Global control, automation and commands. It shall allow for global set point management, control and schedules without the need to go site-by-site. It shall allow for grouping of points, devices, buildings or regions so that changes or rules may be applied accordingly.

I. User and systems management: System shall include a role-based permission structure for allowing multiple users to access the system. Logging of access for tracking authorized and unauthorized connections shall be included.

2.5 NETWORK COMMUNICATION AND SECURITY

A. The following networks (serial, IP, etc.) shall be communication capabilities of the system

1. IP network for connecting the Building Layer to the Cloud Layer

2. IP network for connecting IP enabled devices to the Master Building Controller

3. MS/TP network for connecting serial devices to the Master Building Controller

B. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet network. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.

1. Install new wiring and network devices as required to provide a complete and workable control network.

2. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

3. Operator interface and value passing shall be transparent to architecture.

4. An operator interface connected to a controller shall allow the operator to interface with each integrated controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each controller.

5. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies as shown on the drawings. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

C. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

D. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

E. Network & Application Security

1. The system shall allow only secure remote access. It shall use an MQTT based communication channel where the master building controller initiates the communication so only outbound network access over a specific TCP port is required. This channel is encrypted and also includes facilities for bi-directional authentication and subsequent communication for a higher level of security than VPN based communication methods.

2. All communication shall be encrypted using TLS version 1.2 or later. The system should support role-based access control (RBAC) so different roles can be defined for users in according to their responsibilities, along with the corresponding applications and access rights.

3. A REST based API that is communicated with over HTTPS shall be available.

2.6 OPERATOR INTERFACE

A. A cloud based internet appliance shall be used to provide Human to Machine interface with the CBMS. Owner shall provide

1. Web client shall, at a minimum, support the following tablets:
   a. Android platform:
      1) Google Nexus
      2) Samsung Galaxy Note
   b. Apple platform
      1) Ipad
      2) Apple Ipad Mini

2. Smart mobile phone application shall, at a minimum, support the following platforms and download location:
   a. Android platform and Google Play Store
   b. Apple iOS platform and iOS App Store

3. Operator’s workstation(s) shall be any laptop or desktop computer with the minimum requirements:
   a. Web Brower Application: Internet Edge, Firefox, Chrome, or Safari, with auto update enabled.
   b. Internet access

1.10 WIRING AND RACEWAYS

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.
C. Wiring used for analog signal transmission shall be Class 2 shielded twisted pair.
D. Wiring sizes shall be calculated by the BMCS installed, however, wiring used for analog signals transmission service shall be no smaller than 18 gauge.
E. Wiring shall be installed in a neat and workmanlike manner.
    1. Plenum cable shall be used in accessible locations as allowed by code.
    2. EMT Conduit will be used in areas that may be damaged and concealed inaccessible areas.
    3. Conduit for exterior use shall be rated for such use.

PART 3 - EXECUTION

3.1 COMMISSIONING

A. Provide digital assistance to the commissioning contractor through reports generated by the CBMS.
B. Commissioning report will be in digital format, showing proper point values of the control system as per design.
C. All commissioning will be performed in real time using the system application and all records of the commissioning results saved digitally in a commissioning report.
D. Vendor will remotely manage and provide quality control (QC) commissioning results.

END OF SECTION 23 09 45H

SECTION 23 21 13H

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Joining materials.
4. Transition fittings.
5. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe.
2. Fittings.
3. Joining materials.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.
4. Interior wall and soffit framing

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. The ***Owner's Representative*** reserves the right to test the work of any welder employed on the project, at the Owner's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Condensate-Drain Piping: 212 deg F.
2. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Annealed-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. Description:

    a. Nonconducting materials for field assembly of companion flanges.

    b. Pressure Rating: 150 psig.
    c. Gasket: Neoprene or phenolic.
    d. Bolt Sleeves: Phenolic or polyethylene.
    e. Washers: Phenolic with steel backing washers.

C. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Grinnell Mechanical Products.
    b. Precision Plumbing Products.
    c. Victaulic Company.

2. Description:

    a. Standard: IAPMO PS 66.
    b. Electroplated steel nipple, complying with ASTM F 1545.

    c. Pressure Rating: 300 psig at 225 deg F.
    d. End Connections: Male threaded or grooved.
    e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Low Pressure Steam piping, aboveground, NPS 2-1/2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Type L, drawn-temper copper tubing, wrought-copper pro-press fittings, and joints.

B. Makeup-water piping installed aboveground shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Type L, drawn-temper copper tubing, wrought-copper pro-press fittings, and joints.
3. Schedule 80 CPVC plastic pipe and fittings, and solvent-welded joints.

C. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves. Group piping whenever possible at common elevations.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install unions in piping, NPS 2-1/2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

P. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

END OF SECTION 23 21 13H

SECTION 23 31 13H

HVAC METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ducts and fittings.
2. Sheet metal materials.
3. Flexible Ducts.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Duct leakage testing.

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 07 13 “HVAC Duct Insulation”.
3. Section 23 33 00 "Air Duct Accessories" for dampers, duct silencers, duct-mounting access doors and panels, turning vanes, and flexible connections.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design:

1. 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.
2. Contractor may change duct sizes from those shown provided pressure drop and velocity remain constant. Duct aspect ratio shall be maximum 3:1 unless approved by owner’s representative.

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", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Flexible ducts.
2. Liners and adhesives.
3. Sealants and gaskets.
4. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement details and spacing.
8. Seam and joint construction and sealing.
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, flexible connectors, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

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. REGULATORY REQUIREMENTS

1. Construct ductwork to NFPA 90A standards.

E. FIELD CONDITIONS

1. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
2. Maintain temperatures within acceptable range during and after installation of duct sealants.
3. Ductwork shall be transported to the site in enclosed vehicles or with ends capped.
4. Do not store ductwork directly on ground or floor.
5. Ductwork stored or stacked on site shall be capped.
6. Installed duct shall be capped at the end of the day. Duct found uncapped after the end of the day shall be cleaned.

PART 2 - PRODUCTS

2.1 SINGLE WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide on joints or formed-on flanges fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 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.

1. Slide on Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
2. Formed on Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
3. Manufacturers

a. Ductmate Industries, Inc.
b. Lockformer.
c. Nexus Inc.
d. Ward Industries

D. Longitudinal Seams: Pittsburgh lock seams fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 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. 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."

F. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch thick or less, with more than 10 sq ft of non-braced panel area unless ducts are lined.

2.2 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.

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."

D. Duct Joints

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 60 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger than 60 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.

4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rub-ber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

    a. Manufacturers

        1) Ductmate Industries, Inc.
        2) Lindab Inc.

E. 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 less than 84 inches diameter with spiral lockseam.
2. Fabricate round ducts larger than 84 inches in diameter with butt-welded longitudinal seams.
3. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

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." 90 degree T's without shoe and pulled fittings are not permitted.

G. Fabricate elbows using die-formed, gored spot welded and sealed, or pleated construction. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Round Elbows 8 Inches and Less in Diameter: 2-piece welded construction, fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate non-standard bend-angle configurations or nonstandard diameter elbows with gored construction.
2. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees. Fabricate non-standard bend-angle configurations or nonstandard diameter elbows with gored construction.
3. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows.

2.3 STAINLESS STEEL DUCT

A. Joints between ductwork and fitting and all connections to equipment included but not limited to connections to fume hoods collars, corrosive chemical storage cabinets, and vapor producing equipment, shall be continuous liquid tight butt welded on the external surface of the duct.

B. Material: Type 316L stainless steel, minimum 18 gage fully welded ductwork and fittings.

C. Joints: TIG welded. Weld may be either butt-weld or swaged joint with lap weld with lap running in direction of airflow. Welding rod shall be type 316L material. MIG welding technique not allowed. Inert gas purging inside ductwork not required.

D. All accessories shall be 316 stainless steel including dampers, air valves, damper hardware, etc.

E. Fit the duct system with copper-grounding straps, connected to the duct and to an effective grounding system.

F. Connections to hoods and equipment:

1. Provide minimum 12" length flanged and bolted stainless steel spool piece connection.
2. Flanges: Shall be 316 stainless steel of fabricated 12 gage sheet metal or van stone flanges. Bolts and wing-nuts shall be type 316 stainless steel.

3. Flange gasket material: EPDM minimum 1/16” thick.

2.4 MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation (except as noted below): G60 .
2. Galvanized Coating Designation for outside air intake ductwork, outdoor unjacketed ductwork, and as otherwise noted: G90 .
3. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

E. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

F. 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.

G. 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 .

H. Duct Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during transportation and construction.

1. Product: DynAir Duct Protection Film or equivalent.
2. High tack water-based adhesive.
3. Thickness: 2 mils.
4. UV stability.
5. VOC content: zero.
6. Elongation before break: minimum 325 %.

2.5 DUCT LINER

A. General Requirements:

1. No fiberglass duct liner is allowed.
2. Service temperature: -20 deg F to 250 deg F.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
4. NFPA 90A and NFPA 90B compliant.
5. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
6. Passes ASTM C665 and C1338 for fungi resistance and mold growth.

B. Polyester Duct Liner:

1. Manufacturers:

    a. Ductmate - PolyArmor.
    b. Or engineer-approved equivalent.

2. K value: ASTM C518, 0.24 at 75 deg F; R-value per inch: 4.2.
3. Minimum Noise Reduction Coefficient (NRC): 0.65 at 1 inch thickness.
4. Maximum moisture sorption: 2% by weight.
5. Minimum 25% recycled content.
6. Volatile Organic Content (VOC): 0 ppm.
7. Water-Based Liner Adhesive.

C. Polyamide Foam Duct Liner:

1. Manufacturers:

    a. Boyd Corporation – Solcoustic.
    b. Or engineer-approved equivalent.

2. K value: ASTM C518, 0.30 at 75 deg F; R-value per inch: 3.3.
3. Minimum Noise Reduction Coefficient (NRC): 0.70 at 1 inch thickness.
4. Maximum moisture sorption: 2% by weight.
5. Mechanical Fasteners:

    a. Suitable for attachment to duct without damaging liner as recommended by manufacturer.
    b. Pin length: as required. Pin shall project no more than 1/8 inch (3 mm) into air stream.

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.6 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 (ASTM E84); certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on or spray on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. Volatile Organic Content (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, stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Single-component, acid-curing, silicone, elastomeric. Comply with ASTM C 920, Type S, Grade NS, Class 25, Use O.

1. 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).
2. 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."

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2.7 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 (Table 5-1M), "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.

2.8 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

1. Basis of Design: Mason SCB.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install 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 at least 1 inch plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches .

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "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."

M. Under no circumstances will any labels be permitted on interior surfaces of ductwork. Any materials delivered to the jobsite with interior labels shall be physically and chemically cleaned to remove all remnants of the tag and/or adhesive used to place it.

N. Where connecting flexible duct to metal duct the inner lining shall be placed a minimum of 6 inches over the metal. A zip tie shall be placed over the joint and the flexible duct collar attached with a minimum of three sheet metal screws with foil tape provided to seal the end. The duct insulation shall cover this assembly with the outer membrane covering the insulation and sealed with tape having an integral vapor barrier.

O. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

P. Duct Tape is not permitted.

Q. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

R. Aluminum ductwork shall be used to handle moisture-laden air from shower rooms, shower drying rooms. Slope duct up at minimum 1% slope away from exhaust grille for minimum of 10 feet.

S. At exterior wall louvers, seal duct to louver frame. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Insulate unused portion of outside air intake or exhaust louvers, and duct to the insulated isolation damper. Blank-out material shall be same material as duct, painted black on exterior side. Install outside air intakes to pitch (1 inch per 20 feet) toward intake louver where possible, provide a low point drain prior to equipment where intake duct must slope down from louver. Seal ducts seams to form watertight joints.

T. Install minimum 10 feet of stainless steel duct after all duct mounted humidifiers with bottom surface sloped back at 1% to humidifier dispersion tube.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements. Comply with ASTM A780.

3.3 ADDITIONAL EXTERIOR DUCT INSTALLATION REQUIREMENTS

A. Exterior ductwork under negative pressure shall be so designed and constructed that rainwater on the duct surface cannot be drawn into the duct to reappear inside the building.

B. Exterior ductwork under positive pressure is to be made watertight with exterior waterproof sealant.

C. The cross section of all exterior ductwork shall be pitched at 1 percent slope such that water drains from the top of the duct to one or both sides of the duct, and does not pool on the top.

D. Paint exposed roof mounted ductwork; color to be per Architect requirements.

3.4 ADDITIONAL WELDED DUCT REQUIREMENTS

A. All welded duct may be butt-welded or joggle welded. Where joggle welds are used on fume exhaust systems, the lip formed on the interior surface shall be oriented downstream of the airflow to minimize pockets where condensed liquids may collect.

B. Welded duct sections shall be verified to be continuous and free of leakage prior to shipment from the fabrication facility. Leakage testing may be accomplished utilizing either light or pressurization.

C. Welds on exposed ductwork in occupied spaces shall be prepared as follows:

1. Stainless Steel #2B: Standard stainless steel finish used for ductwork, exhaust stacks, within mechanical spaces, low wall returns, fume hoods, back of house systems, etc. Welds shall be brushed and painted with Chrome Aluminum paint.
2. Stainless Steel #4: Exposed aesthetic architectural finish. Only shall be used when specified on drawings or elsewhere in the specifications. Finish shall be prepared to a kitchen grade finish with welds ground smooth and brush polished to restore the #4 finish.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 INTERNAL LINING IINSTALLATION

A. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.7 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 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet .

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.8 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet on.center, and longitudinal supports a maximum of 80 feet on center.
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 [the Office of Statewide Health Planning and Development for the State of California][an agency acceptable to authorities having jurisdiction].

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.9 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.10 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting.".

3.11 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 of positive 3-Inch wg or higher or negative 3-Inch wg or lower: Test 100 percent of total installed duct area for each designated pressure class.
    b. Ducts with a Pressure Class between positive 2-Inch wg and negative 2-Inch wg , inclusive: Test representative duct sections, selected by Design Engineer, totaling no less than 25 percent of total installed duct area for each designated pressure class.
    c. Risers and all supply and exhaust branch ducting shall be tested to within 5 feet of a diffuser collar or the point of connection to an exhaust device, respectively.
    d. Welded Exhaust Ducts: Test 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DUCT SCHEDULE

A. Fabricate ducts of galvanized steel except as otherwise indicated and as follows:

Table: Duct Schedule

Type	Material	Pressure Class	Rect. Leakage Class	Round Leakage Class	Seal Class
Supply Mains	Galvanized	+ 4" w.g.	6	3	A
Return	Galvanized	- 2" w.g.	24	12	C
Transfer	Galvanized	- 1" w.g.	24	12	C
General Exhaust	Galvanized	- 2" w.g.	12	6	B

A. Liner:

1. Supply Air Ducts: Polyester, 1 inch (25 mm) thick.
2. Return Air Ducts: Polyester, 1 inch (25 mm) thick.
3. Exhaust Air Ducts: Polyamide, 1 inch (25 mm) thick.
4. Supply Fan Plenums: Polyamide, 2 inches (51 mm) thick.
5. Return- and Exhaust-Fan Plenums: Polyamide, 2 inches (51 mm) thick.
6. Transfer Ducts: Polyamide, 1 inch (25 mm) thick.

B. 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 (5 m/s) or Lower:

        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
        2) Mitered Type RE 4 without vanes.

    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with 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 (7.6 m/s) or Higher:

        1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with 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 two vanes.
    c. Mitered Type RE 2 with 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.
    b. Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    c. Velocity 1000 to 1500 fpm : 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    d. Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    e. Radius-to Diameter Ratio: 1.5.
    f. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    g. Round Elbows, 14 Inches and Larger in Diameter: Welded.

C. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 00H

SECTION 23 33 00H

HVAC DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Barometric relief dampers.
2. Manual volume dampers.
3. Duct silencers.
4. Turning vanes.
5. Duct-mounted access doors.
6. Flexible connectors.
7. Duct accessory hardware.

B. Related Requirements:

1. Division 07 for Firestopping.
2. Section 23 31 00 “HVAC Metal Ducts” for flexible ducts.
3. Division 26 for wiring connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.

d. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Sound Attenuators

1. All tests shall be conducted by a laboratory that is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) to conduct the test. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Where test data is obtained in the manufacturer's laboratory, the facility shall be available for inspection and witnessed testing by the architect, mechanical engineer and acoustical consultant in order to verify compliance with the latest edition of ASTM Standard E477 or a test standard approved by the acoustical consultant. The architect or project acoustical consultant shall be the final arbiter in determining compliance.
2. Manufacturer’s Experience: The manufacturer shall have successful experience in duct silencer production, including no less than five years experience in fabrication and delivery of duct silencers equal in size and quantity to this work. The Manufacturer shall be capable of supplying references and acoustical test results for up to five recently completed projects similar to this work.
3. Acoustical and Aerodynamic Performance: Duct silencer acoustical and aerodynamic performance shall be determined in accordance with the latest edition of ASTM Standard E477-90 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers or a test standard approved by the acoustical consultant. All silencer ratings shall be determined in a duct-to-reverberant room test facility that provides for airflow in both directions through the test silencer in accordance with the latest edition of ASTM E-477 test standard or a test standard approved by the acoustical consultant. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.
4.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Provide duct accessories of materials suited to associated duct materials.

D. Air extractors shall not be used, except with the expressed written consent of the Design Engineer.

2.2 BAROMETRIC RELIEF DAMPERS

A. Description: Counterbalanced backdraft damper.

1. Sensitivity: 0.01 inch w.g. differential pressure.
2. Frame : extruded aluminum channel, front and rear flanges.
3. Blades: Single-piece, parallel, minimum 28 gage aluminum
4. Blade Seals: Extruded vinyl, mechanically locked maximum 6” width.
5. Bearings: Synthetic
6. Counterbalance: zinc plated adjustable steel weights attached to blades.
7. Accessories:

    a. Screen Mounting: Front mounted in sleeve.

        1) Sleeve Thickness: 20 gage minimum.
        2) Sleeve Length: 6 inches minimum.

    b. Screen Mounting: Rear mounted.
    c. Screen Material: Galvanized steel.
    d. Screen Type: Insect.

2.3 MANUAL VOLUME DAMPERS

A. General Description: Factory fabricated, with required hardware and accessories.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Damper Frame: hat-shaped, material shall match associated ductwork.

D. Flanges for attaching to walls and flangeless frames for installing in ducts.

E. Manufacturers:

1. Ruskin.
2. Louvers and Dampers.
3. Nailor Industries.

F. Standard Manual Volume Dampers (2-inch wg and below):

1. Frame: 3 inch deep, minimum 20 gauge galvanized steel.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.

4. Maximum Air Velocity: 1500 fpm.
5. Maximum System Pressure: 2 inch w.g.
6. Axles:

    a. 18” wide and below: minimum 3/8” square extended beyond frame with standoff bracket.
    b. 19” wide and above: minimum 1/2” square extended beyond frame with standoff bracket.

7. Blades:

    a. Stiffened, opposed-blade design.
    b. 18” wide and below: 22 gauge.
    c. 19” wide and above: 16 gauge.
    d. Include locking hand quadrant to hold single-blade dampers in a fixed position without vibration.

8. Bearings: Molded synthetic.

2.4 DUCT SILENCERS

A. Manufacturers:

1. Vibro-Acoustics.
2. Ruskin.
3. Kinetics Noise Control.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.

3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.
6. Rectangular Packless

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel,

1. Sheet Metal Thickness for straight units 0.034 inch thick.
2. Sheet Metal Thickness for elbow units 0.060 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.05 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal

1. Sheet Metal Thickness for straight units 0.018 inch thick
2. Sheet Metal Thickness for elbow units 0.030 inch thick.
3. Sheet Metal Thickness for circular units through 18 inches 0.018 inch thick
4. Sheet Metal Thickness for circular units above 18 inches 0.030 inch thick

G. Special Construction:

1. Suitable for outdoor use.

2. High transmission loss walls

H. Connection Sizes: Provide transition to and from connecting ductwork to schedule silencer size.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.

2. Dissipative Film-lined type with fill material.

a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression.
b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
c. Glass fiber and fiber glass will not be permitted.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Joints: Lock formed and sealed.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.

L. Source Quality Control: Test according to ASTM E 477.

2.5 TURNING VANES

A. Manufacturers:

1. Duro Dyne Inc.
2. Ductmate Industries.

3. Metalaire.
4. Ruskin.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Single Wall: 3/4 inch trailing edge and 2 inch radius.

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

E. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

2.6 REMOTE CABLE-DRIVEN VOLUME DAMPER OPERATORS

A. Manufacturers:

1. Pottorff.
2. Ventfabrics, Inc.
3. Ventlok.
4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

1. Provide package for complete workable system for remote damper operation.
2. Pressure Rating: 1-inch w.g.
3. Velocity Rating: 1,500 FPM.
4. Tubing: Plastic.
5. Cable: Stainless steel, 50 feet maximum length.
6. Wall-Box Mounting:

a. Recessed, with tamper-proof, stainless steel cover plate.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall; insulation fill and thickness as indicated for duct pressure class, minimum 1 inch.
b. Hinges and Latches: continuous piano hinge and cam latches.
c. Shape and material to match ductwork.
d. Fabricate doors airtight and suitable for duct pressure class.
e. Doors shall open against air pressure.

f. On access doors on ducts of 4 inch w.g. pressure or greater, provide sign reading “CAUTION – DOOR CLOSES WITH AIR PRESSURE”.

2. Frame duct opening with continuous 1 inch by 1 inch angle. Provide sponge rubber or neoprene gasket at door-to-frame and frame-to-duct.

2.8 FLEXIBLE DUCTS

A. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Manufacturers:

a. Casco L-181M.
b. Flexmaster USA 1NI.
c. Thermaflex MC.

2. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg negative.
3. Maximum Air Velocity: 4000 fpm .
4. Temperature Range: Minus 10 to plus 160 deg F .
5. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
6. NFPA 90A and NFPA 90B compliant.

B. Acoustically Rated, Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; vapor-barrier film.

1. Manufacturers:

a. Casco SF-181M.
b. Flexmaster USA 1B.
c. Thermaflex M-KE.

2. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
3. Maximum Air Velocity: 4000 fpm .
4. Temperature Range: Minus 20 to plus 175 deg F .
5. Water Vapor Permeance: maximum 0.17 perms (ASTM E 96, Procedure A).
6. Insulation R-Value: R-4.2 minimum at 70 deg F.
7. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
8. NFPA 90A and NFPA 90B compliant.
9. The sound attenuation (insertion loss) of the acoustical flexible air duct shall meet or exceed the values tabulated below

Straight Duct Insertion Loss in Decibels per Length of 10 Feet with No Airflow

Acoustical Flexible Air Duct Inner Diameter	Octave Band Center Frequency (Hz)						
	125	250	500	1000	2000	4000	8000
6 Inches	20	25	30	33	30	25	22
10 Inches	18	20	25	28	25	22	20
16 Inches	15	18	20	25	22	15	15

C. Flexible Duct Attachment:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches , to suit duct size.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Durodyne.
2. Ventfabrics.

B. Materials: Flame-retardant or noncombustible fabrics. NFPA 90A compliant.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.10 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

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. 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. Provide elevated dial or shaft extension for insulated ducts.

1. Utilize aluminum framed and blades for volume dampers in wet air streams, utilize galvanized steel blades and frames in all other locations.
2. Cut slot in end of volume damper rod (Quadrant End) to indicate blade position.
3. Provide galvanized sheet metal "hat section" for volume dampers on ducts with exterior insulation so that quadrant will be exposed.
4. Unless indicated otherwise below or on drawings volume dampers shall be standard design:

a. Spaces with sound rating NC 30 and below: **Low Leakage**

C. Install cable-driven remote volume dampers for all volume dampers located in inaccessible ceilings or as indicated on Contract Drawings.

1. Locate wall box within 10 feet in accessible location.
2. Wall box shall be recessed-type in finished spaces.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Locate duct silencers a minimum of two equivalent duct diameters from elbows and fittings.

G. Sound Attenuators

1. Install where shown on Drawings in accordance with the manufacturer's recommendations to obtain the published acoustical and air flow performance.
2. Duct Silencer baffles should be oriented so as to be parallel to the plane of the turn if the silencer is located in a position less than 3 duct diameters in distance from the elbow. The duct diameter shall be based upon the maximum duct cross sectional dimension of the sound attenuator.
3. Do not locate rectangular sound attenuators within one duct diameter from elbows, fan suction or discharge openings, takeoffs, etc.
4. Support duct silencers independent of ductwork, provide seismic bracing.

H. Install turning vanes in all rectangular elbows.

1. Ductwork of pressure class +/- 2-inch w.g. or lower: single wall vanes.
2. Ductwork of pressure class +/- 3-inch w.g. and greater: double wall vanes.
3. Acoustical turning vanes are not to be used unless specifically indicated on the Contract Drawings.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At drain pans and seals.
2. Downstream from control dampers, and equipment.
3. Control devices requiring inspection.
4. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. Rectangular duct larger than 30 inches: 24 by 24 inches.
2. Rectangular duct up to 30 inches: 16 by 20 inches.
3. Rectangular duct up to 18 inches: 12 by 12 inches.
4. For ducts smaller than 18 inches: 2 inch12 inch

L. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install duct test holes where required for testing and balancing purposes.

N. Flexible Connectors

1. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
2. Allow at least 1 inch slack in flexible connections to insure that no vibration is transmitted from fan to ductwork

3. On fans with a total static pressure of 5 inch w.g. or greater, 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.

O. Flexible Duct

1. Connect diffusers or light troffer boots to low pressure ducts with maximum 84-inch lengths of flexible duct clamped or strapped in place.
2. Connect flexible ducts to metal ducts with draw bands.
3. Installation of the acoustical flexible air duct shall be in accordance with the manufacturer's instructions and recommended procedures. Bends shall not have a radius of curvature smaller than 1.5 duct diameters. Before entering the rear of any diffuser, flexible duct must be straight and perpendicular to the diffuser for a minimum of 3 duct diameters.
4. Flexible duct must not be installed directly at the inlet or discharge of any volume control device

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

SECTION 23 41 00H

PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Flat panel filters.
2. Pleated panel filters.
3. Nonsupported bag filters.
4. Rigid cell box filters.
5. Filter gages.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Sustainable Design Submittals:

1. Product Data: For air filtration performance.

C. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
3. Include diagram for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set(s) of filters for each filter bank. If system includes prefilters, provide only prefilters.
2. Provide one container(s) of red oil for inclined manometer filter gage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Comply with NFPA 90A and NFPA 90B.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FLAT PANEL FILTERS

A. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames complying with UL 900.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AAF International.
b. Camfil Farr.
c. Flanders Corporation.
d. Purafil, Inc.

B. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Media shall be coated with an antimicrobial agent.
2. Metal Retainer: Upstream side and downstream side.

C. Filter-Media Frame: Cardboard with perforated metal retainer sealed or bonded to the media.

D. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames complying with UL 900.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AAF International.
    b. Camfil Farr.
    c. Flanders Corporation.
    d. Purafil, Inc.

B. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Media shall be coated with an antimicrobial agent.
2. Separators shall be bonded to the media to maintain pleat configuration.
3. Welded-wire grid shall be on downstream side to maintain pleat.
4. Media shall be bonded to frame to prevent air bypass.
5. Support members on upstream and downstream sides to maintain pleat spacing.

C. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

D. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.4 NONSUPPORTED BAG FILTERS

A. Description: Factory-fabricated, dry, extended-surface, nonsupported filters with header frames complying with UL 900.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AAF International.
    b. Camfil Farr.
    c. Flanders Corporation.
    d. Purafil, Inc.

B. Media: Synthetic material constructed so individual pockets are maintained in tapered form under rated-airflow conditions by flexible internal supports.

1. Media shall be coated with an antimicrobial agent.

C. Filter-Media Frame: Galvanized steel.

D. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.5 RIGID CELL BOX FILTERS

A. Description: Factory-fabricated, disposable, packaged air filters with media perpendicular to airflow, and with holding frames complying with UL 900.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AAF International.
    b. Camfil Farr.
    c. Flanders Corporation.
    d. Purafil, Inc.

B. Filter Unit Class: UL 900.

C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.

1. Media shall be coated with an antimicrobial agent.

D. Filter-Media Frames: Galvanized steel.

E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.6 BULK MEDIA

A. Description: Air-filter media, factory custom cut or rolled complying with UL 900.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AAF International.
    b. Camfil Farr.
    c. Flanders Corporation.
    d. Purafil, Inc.

B. Media: Synthetic, in a roll.

C. Capacities and Characteristics:

1. Thickness or Depth: 1 inches.
2. Maximum or Rated Face Velocity: 800 fpm.
3. Arrestance: 85 percent when tested according to ASHRAE 52.2.

4. MERV Rating: 6 when tested according to ASHRAE 52.2.

2.7 FILTER GAGES

A. Diaphragm-type gage with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AirGuard; Clarcor Air Filtration Products, Inc.
    b. Dwyer Instruments, Inc.

2. Diameter: 4-1/2 inches.

3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg or Less: 0- to 0.5-inch wg.
4. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1.0-Inch wg or Less: 0- to 1.0-inch wg.
5. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg or Less: 0- to 2.0-inch wg.

B. Manometer-Type Filter Gage: Molded plastic, with epoxy-coated aluminum scale and logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg, and accurate within 3 percent of the full-scale range.

C. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

F. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

G. Coordinate filter installations with duct and air-handling-unit installations.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Test for leakage of unfiltered air while system is operating.

C. Air filter will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 23 41 00H

SECTION 23 74 13H

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Heat-pump refrigeration components.
3. Hot-gas reheat.
4. Gas furnace.
5. Economizer outdoor- and return-air damper section.
6. Integral, space temperature controls.
7. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AMCA 99—Standards Handbook

C. AMCA 210—Laboratory Methods of Testing Fans for Rating Purposes

D. AMCA 500—Test Methods for Louver, Dampers, and Shutters.

E. AHRI 340/360 - Unitary Large Equipment

F. NEMA MG1—Motors and Generators

G. National Electrical Code.

H. NFPA 70—National Fire Protection Agency.

I. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.

J. UL 900—Test Performance of Air Filter Units.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with seismic performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.6 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports 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 requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

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 test reports.

D. Warranty: Special warranty specified in this Section.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: One set of filters for each unit.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.

B. Startup must be done by trained personnel experienced with rooftop equipment.

C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site and inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.12 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation.
2. Daikin Applied.
3. Trane.
4. YORK; a Johnson Controls company.

2.2 GENERAL

A. Configuration: Fabricate as detailed on prints and drawings:
   1. Return plenum /economizer section
   2. Power Exhaust
   3. Filter section
   4. Cooling coil section
   5. Supply fan section
   6. Gas heating section.
   7. Modulating Hot gas reheat coil (Gallery Units only)
   8. Condensing unit section

B. The complete unit shall be cETLus listed.

C. The unit shall be ASHRAE 90.1-2016 compliant and labeled.

D. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

E. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

F. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

G. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

2.3 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed. Panel

B. Cabinet shall be designed to operate at total static pressures up to 5-inches w.g.

C. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

   1. Exterior Casing Thickness: minimum 0.0626 inchthick.

   2. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure.

D. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, minimum 0.028 inch thick.

E. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance.

F. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

G. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

H. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: Two Part injected foam or fiberglass complying with ASTM C 1071, Type I.
2. Thickness: 1 inch
3. R-value: 7 deg F-ft-hr/BTU
4. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
5. Liner Adhesive: Comply with ASTM C 916, Type I.

I. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, double sloped complying with ASHRAE 62.1.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

J. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.4 SUPPLY FANS

A. Direct-Driven Supply-Air Fans: Class II, Single width single inlet, airfoil centrifugal; with permanently lubricated, EC motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

C. Supply fan and motor assembly combinations larger than 8 hp or 22” diameter shall be internally isolated on 1” deflection, spring isolators and include removable shipping tie downs.

D. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

F. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces.

G. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.5 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
4. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
5. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
6. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1. The drain pan shall have a threaded drain connection extending through the unit base.

B. Hot-Gas Reheat Refrigerant Coil:

1. Units serving the gallery shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser
2. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
3. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.
4. Each coil shall be factory leak tested with high-pressure air under water.
5. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.6 CONDENSING SECTION

A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

B. Outdoor air coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating.

C. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25-120°F. Mechanical cooling shall be provided to 25º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

D. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material

E. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

F. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

G. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

H. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

I. Refrigeration Specialties:
   1. Refrigerant: R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.
   9. Low-ambient kit high-pressure sensor.
   10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.

2.7 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

   1. CSA Approval: Designed and certified by and bearing label of CSA.
   2. The module shall be complete with furnace controller and control valve capable of 10:1 modulating operation.

B. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

C. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner

manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.

D. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.

E. Burners: Stainless steel.

1. Fuel: Natural gas.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

F. Heat-Exchanger and Drain Pan: Stainless steel.

G. Venting: Gravity vented with vertical extension.

H. Safety Controls:

1. Gas Control Valve: Modulating.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 EXHAUST FAN (NON-GALLERY UNITS ONLY)

A. Exhaust fan, shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

B. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

C. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

2.9 DAMPERS

A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature.

B. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream.

C. The outside and return air dampers shall be sized to handle 100% of the supply air volume.
1. The dampers shall be parallel blade design.

2. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in according with testing defined in AMCA 500.

D. Control of the dampers shall be by a factory installed direct coupled actuator.
   1. Damper actuator shall be of the modulating, spring return type.
   2. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

E. Economizer assembly Fault Detection and Diagnostics (FDD) shall be 90.1, IECC, and California Title 24 compliant. MicroTech III controls shall display a warning, and write a warning to the BAS, if the economizer malfunctions in accordance with 90.1, IECC, and Title 24 specifications.

2.10 FILTERS

A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" MERV 8 prefilter and a 4" MERV 14, final filter.

B. The unit design shall have a hinged access door for the filter section.

C. The manufacturer shall ship the rooftop unit with 2" MERV 8 and 4" MERV 14 filters.

2.11 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted fused 65,000 amp SCCR capability disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

B. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification.

C. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection.

D. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit.

E. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection.

F. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

2.12 CONTROLS

A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including humidity control, temperature control, scheduling, monitoring,

unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate standalone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:
   1. Return air temperature.
   2. Discharge air temperature.
   3. Outdoor air temperature.
   4. Space air temperature.
   5. Outdoor enthalpy, high/low.
   6. Compressor suction temperature and pressure
   7. Compressor head pressure and temperature
   8. Expansion valve position
   9. Condenser fan speed
   10. Inverter compressor speed
   11. Dirty filter indication.
   12. Airflow verification.
   13. Cooling status.
   14. Control temperature (Changeover).
   15. Cooling status/capacity.
   16. Unit status.
   17. All time schedules.
   18. Active alarms with time and date.
   19. Previous alarms with time and date.
   20. Optimal start
   21. Supply fan and exhaust fan speed.
   22. System operating hours.
      a. Fan

b. Exhaust fan
c. Cooling
d. Inndividual compressor
e. Heating
f. Economizer

G. The user interaction with the keypad shall provide the following:
1. Controls mode
a. Off manual
b. Auto
c. Heat/Cool
d. Cool only
e. Heat only
f. Fan only
2. Occupancy mode
a. Auto
b. Occupied
c. Unoccupied
d. Tenant override
3. Unit operation changeover control
a. Return air temperature
b. Space temperature
c. Network signal
4. Cooling and heating change-over temperature with deadband
5. Cooling discharge air temperature (DAT)
6. Supply reset options
a. Return air temperature
b. Outdoor air temperature
c. Space temperature
d. Space Relative Humidity
e. Airflow (VAV)
f. Network signal
g. External (0-10 vdc)
h. External (0-20 mA)
7. Temperature alarm limits
a. High supply air temperature
b. Low supply air temperature
c. High return air temperature
8. Lockout control for compressors.
9. Compressor interstage timers
10. Night setback and setup space temperature.
11. Building static pressure.
12. Economizer changeover
a. Enthalpy
b. Drybulb temperature
13. Currently time and date
14. Tenant override time
15. Occupied/unoccupied time schedule
16. One event schedule
17. Holiday dates and duration
18. Adjustable set points
19. Service mode
a. Timers normal (all time delays normal)
b. Timers fast (all time delays 20 sec)

H. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
   1. Airflow
   2. Outside air temperature
   3. Space temperature
   4. Return air temperature
   5. External signal of 1-5 vdc
   6. External signal of 0-20 mA
   7. Network signal

I. Basic Unit Controls:

   1. Control-voltage transformer.
   2. Wall-mounted thermostat or sensor with the following features:

      a. Heat-cool-off switch.
      b. Fan on-auto switch.
      c. Fan-speed switch.
      d. Manual changeover.
      e. Adjustable deadband.
      f. Concealed set point.
      g. Exposed indication.
      h. Degree F indication.
      i. Unoccupied-period-override push button.
      j. Data entry and access port to input temperature and humidity set points, occupied and unoccupied periods, and output room temperature and humidity, supply-air temperature, operating mode, and status.Retain first subparagraph and associated subparagraphs below for hot-gas reheat feature.

   3. Duct-mounted humidistat or sensor with the following features:

      a. Concealed set point.
      b. Concealed indication.

2.13 THERMOSTATS, DIRECT DIGITAL

A. General
   1. Thermostat shall consist of a sensing element within a ventilated cover.
   2. Cover shall be aesthetically pleasing and designed for wall box mounting in occupied space.
   3. Provide with insulated base and wall box.
   4. For thermostats connected to terminal box controller that requires calibration, include port for connection of POT or laptop.

B. Communication
   1. Contract Drawing control schematics may show hardwired point connections but thermostat may connect to BAS via any of the following methods:
      a. Hardwired points (4-20 mA or 0-10 V)
      b. Connected directly to unit controller.

C. Thermostat Types
   1. Type 1 – No Display, No Controls

a. Blank cover
b. No occupant controls

2. Type 2 – With Display, No Controls
   a. Cover shall include integral LCD display showing current temperature and active setpoint.
   b. No occupant controls.
3. Type 3 – With Display, With Controls
   a. Display per Type 2 thermostat.
   b. Include means for occupant to adjust setpoint (buttons, dials, or sliders).
      1) Heating and cooling setpoint shall be independently adjustable.
      2) Setpoint adjustment shall be capable of being limited by BAS in software. If setpoint limitation function resides in thermostat, limits must be adjustable though BAS interface. Devices which require setpoint limitations to be programmed at the thermostat are not acceptable.
   c. Include override pushbutton ("janitor's button") capable of being programmed to start system outside of scheduled occupancy.
4. Type of thermostat depends on the type of space in which it is installed. See Paragraph **Error! Reference source not found.**.

D. Manufacturers (alphabetical order)
1. Automated Logic Corp
2. Building Automation Products Inc
3. Kele Associates
4. Mamac
5. Or equal

2.14 CARBON DIOXIDE SENSORS

A. General
1. CO2 sensors are delicate optical instruments. Protect from shock. Store in manufacturer's packaging until ready for installation. Recalibration may be required after rough handling.
2. Detachable base with all field wiring termination on base.
3. Provide wall-mounted sensors with display; duct-mounted sensors do not require display.
4. Provide duct-mounted sensors with aspirating probe.
5. Wall-mounted sensors may be combined/integrated with thermostat.
6. Factory calibrated and set to 0-2000 PPM range
7. Drift shall not exceed 2%.
8. Response time shall be 1 minute or less.
9. Sensor shall not require recalibration for a minimum of 5 years, guaranteed.
10. If sensor is found to be out of calibration, DDC Contractor shall recalibrate or replace at no additional cost to the Owner within 5 years of purchase date.
11. Rated ambient conditions:
    a. Air temperature: 32ºF - 120ºF
    b. Relative humidity: 0% - 95% non-condensing
12. Include elevation adjustment
13. Signal output: 4-20 mA or 0-10 V, or as BACnet networked device on secondary control LAN.

B. Single Channel ABC Sensor (Type 1)
1. Non-dispersive single beam infrared sensor.
2. Accuracy: larger of ±30 PPM or ±3% of reading from 0 to 1,250 PPM at temperatures from 60°F to 90ºF

3. Sensor shall include automatic background calibration (ABC) technology to compensate for the aging of the infrared source.
4. Manufactuers (alphabetical order)
    a. AirTest TR929x series
    b. Telaire T8100/8300
    c. Or equal

2.15 HUMIDITY SENSORS

A. General
1. Sensor shall be thin film capacitance type.
2. Sensor element shall be field-replaceable without requiring recalibration.
3. Shall include 2-wire transmitter producing a continuous 4-20 mA signal proportional to relative humidity (%RH) or output as required (see Paragraph 2.15A.12).
4. Temperature range: 32ºF to 122ºF
5. Humidity range: 0% to 100% RH
6. Sensor shall be factory-calibrated and NIST traceable.
7. Resolution: 0.1% RH
8. Repeatability: 0.5% RH at RH < 90%
9. Temperature Effect: Less than 0.06% per ºF at baseline of 70ºF.
10. Response time at 70ºF in still air: Less than 20 seconds
11. Provide sensor with cover suitable duct installation as required by application.
    a. For wall mounting: Aesthetically pleasing ventilated cover, designed for wall box mounting in occupied space, with insulated base.
    b. For duct mounting: Junction box for wiring connections and gasket to prevent air leakage and vibration noise. Sensor probe shall extend into duct at least 20% of duct width.
12. Sensor shall output relative humidity (%), dewpoint temperature, or wetbulb temperature as indicated on control drawings or as required by the application.
    a. Contractor shall select the model/options to provide required output, or shall configure sensor to provide required outputs, as appropriate to the sensor being used.

B. Ultra High Accuracy (1%)
1. Accuracy at 70°F: no worse than ±1% over 0% - 90% RH; ±2% over 90% - 100% RH
2. Drift: no more than 0.5% per year
3. Manufacturer warranty no less than 10 years
4. Manufacturers (order of preference)
    a. Viasala HMT333 (duct)
    b. No known equal

2.16 CLOUD ENABLED EQUIPMENT

A. DESCRIPTION:
1. The manufacturer shall provide an equipment management solution, which is factory-installed on the HVAC unit. Equipment hardware shall include integrated equipment power measurement and consist of all components necessary to deliver unit controller and power data directly to the cloud. The subscription- based Software as a Service (SaaS) shall allow remote HVAC monitoring, remote HVAC control, preventative maintenance recommendations, and unit commissioning/re-commissioning capabilities using secure, cloud-communicating hardware.

2. The solution shall be capable of communicating to a user device (smart phone, tablet, etc.) via both wireless (cellular, Wi-Fi) and local area network (LAN) connection. All data is stored in the cloud for a minimum of 2 years.

B. CLOUD-COMMUNICATING SMART DEVICE
1. A factory-installed, tested and commissioned cloud-communicating smart device shall deliver data to the cloud via wireless (Wi-Fi, cellular) or local area network (LAN) connection.
2. The cloud-communicating smart device shall implement security, to include:
   a. Data delivery via secure HTTPS using SSL
   b. Virus and Malware protection
   c. Boot-level security
3. Compliance:
   a. CE
   b. FCC Class A/Industry Canada
   c. UL60950 Carrier Approved

C. INTEGRATED POWER METER
1. A factory-installed, tested and commissioned power meter shall monitor unit voltage, current, and power and transmit this data to the cloud- communicating smart device, for delivery to the cloud or shall deliver directly to the cloud.
2. Hardware shall:
   a. Allow monitoring of single-phase, split-phase and 3-phase Y & Delta connections up to 600VAC (45-65 Hz) and up to 1000 A.
   b. UL61010-1/CSA C22.2 No. 61010-1 and UL/CSA 61010-2-030UL recognized

D. INSTALLATION
1. Antennas, or equivalent, if needed shall be shipped loose from the factory, and shall be mounted and electrically-connected in the field by the contractor providing unit start-up and commissioning, per factory-supplied installation literature.
2. For sites using Local Area Network (LAN) connection to provide cloud access, appropriate trades should coordinate to supply all necessary roof penetrations, conduit, network cable, network infrastructure, and termination to the network.

E. START-UP AND COMMISSIONING
1. Initial programming of cloud-communicating smart device and integrated power meter shall be performed at the factory.
2. Commissioning technician will submit the startup and commission documentation through the User Interface.

2.17 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Coil guards of painted, galvanized-steel wire.

2.18 ROOF CURBS

A. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: Height to be coordinated with field conditions by contractor. Curb height shall maintain minimum 12-inch clearance between finished roof surface and underside of package unit..

D. Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

2.19 SEQUENCE OF OPERATIONS

A. Head Pressure Control: The condenser head pressure will be monitored by the unit controller to maintain head pressure and the compressor operating envelope at all times to avoid high pressure trips on high load days. Condenser fans with ECM motors shall be provided as well as factory sensors to provide this protection.

B. Compressor Envelope Control: The unit controller will continually monitor the suction and discharge pressure and temperature conditions during compressor operation. The unit will modulate the compressor, condenser head pressure, and electronic expansion valve to maintain a safe compressor operating conditions to add reliability, and limit unit shut down during fringe operating conditions

C. AC-1,2,7,8,10,11,13,14,15,16

1. Change over setpoints:

a. The unit change over source temperature is the variable, Outdoor air temperature (OAT), Return air temperature (RAT), or space temperature (ST), that drives the change of unit states. The unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

2. Supply fan:

    a. The RTU will be factory supplied with a direct drive supply fan.
    b. Single Zone VAV: The supply fan will operate continuously between a specified minimum and maximum speed. The unit will modulate the supply fan between the minimum and maximum based on how near or far the control temperature (typically space or return temp) is away from setpoint.

3. Outside Air Damper Control:

    a. Proportional damper reset: The unit controller will proportionally modulate the outside air dampers open and closed as the supply fan speed changes to provide a constant volume of fresh outside air.
    b. Outdoor air monitor: The unit controller will modulate the outside air damper as required to maintain the outside air cfm setpoint as measured by the factory provided flow station (Requires Optional OA Monitor).
    c. External Reset: An external 0-10 VDC or 4-20 mA signal can be wired to the unit controller to control the OA damper position by a third party.

4. Cooling:

    a. Discharge Air Control: In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
    b. Cooling DAT reset: The cooling DAT setpoint may be reset by the space temp, return temp, OAT or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

5. Gas Heat

    a. The unit is provided with modulating gas heat.
    b. Modulating Gas Heat: The modulating gas heat will be modulated by the unit controller to maintain the heating DAT set point.
    c. Heating DAT reset: The heating DAT setpoint may be reset by space, return, OAT, Network or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

6. Economizer:

    a. A comparative dry bulb (standard option) or comparative enthalpy (selectable option) shall be engaged whenever the outdoor enthalpy or dry bulb is less than the return air enthalpy or dry bulb to utilize outside air for cooling. Outside air and return air dampers shall modulate to maintain supply air temperature set point.

7. Exhaust Fan Control:

    a. Outdoor Air Damper Tracking: The exhaust fan(s) will activate based on the outside air damper position and will modulate between an adjustable minimum and maximum as the OA damper opens to provide relief.

D. AC-3,4,5

1. Change over setpoints:

    a. The unit change over source temperature is the variable, Outdoor air temperature (OAT), Return air temperature (RAT), or space temperature (ST), that drives the change of unit states. The unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

2. Supply Fan:

    a. The RTU will be factory supplied with a direct drive supply fan.

    b. Constant Volume (CV): The supply fan will operate continuously. The unit will maintain constant volume airflow.

3. Outside Air Damper Control:

    a. Proportional damper reset: The unit controller will proportionally modulate the outside air dampers open and closed as the supply fan speed changes to provide a constant volume of fresh outside air.

    b. Outdoor air monitor: The unit controller will modulate the outside air damper as required to maintain the outside air cfm setpoint as measured by the factory provided flow station (Requires Optional OA Monitor).

    c. External Reset: An external 0-10 VDC or 4-20 mA signal can be wired to the unit controller to control the OA damper position by a third party.

4. Cooling:

    a. Discharge Air Control: In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.

    b. Cooling DAT reset: The cooling DAT setpoint may be reset by the space temp, return temp, OAT or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

5. Gas Heat

    a. The unit is provided with modulating gas heat.

    b. Modulating Gas Heat: The modulating gas heat will be modulated by the unit controller to maintain the heating DAT set point.

    c. Heating DAT reset: The heating DAT setpoint may be reset by space, return, OAT, Network or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

6. Modulating Hot Gas Reheat

    a. The unit is provided with fully modulating, sub cooling, hot gas reheat coil. The control sequence used for dehumidification in a Rebel unit uses two separate points of control. The first point is the leaving coil temperature sensor (LCT), and the second point is the discharge air temperature sensor (DAT). During dehumidification the refrigeration circuit controls the compressor(s) to maintain the LCT setpoint (adjustable) and the reheat coil is controlled to maintain the supply air reheat setpoint. The supply air reheat setpoint changes based on the whether there is a call for both cooling and dehumidification or a call for dehumidification only. When a call for both cooling and dehumidification is made the reheat setpoint is set as the cooling DAT setpoint. During a call for dehumidification only the reheat setpoint is reset in a linear manner between two endpoints referred to as the min

and max reheat setpoints (adjustable). This reset is based on the cooling and heating setpoints for the RTU. This logic will send warmer supply air when the space is approaching the heating changeover setpoint and cooler supply air when the space is approaching cooling changeover setpoint. This logic prevents unnecessary fluctuations between cooling and heating states.

7. Dehumidification

   a. Dehumidification controls allow the unit to cool and dehumidify simultaneously or just dehumidify if no cooling is needed.

   b. To enable the dehumidification sequence the following options are available:

   c. Relative Humidity (Requires a relative humidity sensor) - Dehumidification will be activated when the relative humidity in the return duct, space, or outdoor air rises above the dehumidification set point.

   d. Dew point dehumidification uses a relative humidity sensor, the sensor for the unit controller shall be in the return air. The unit controller will reference the temperature sensor in the specified location and calculate the dew point based on that temperature and the reading from the relative humidity sensor.

8. Outside Air Mixing Box:

   a. Provide mixing box with return and outside air dampers. Dampers to be controlled for constant outside airflow.

9. Barometric Relief:

   a. Provide barometric relief damper.

E. AC-6,9,12

1. Change over setpoints:

   a. The unit change over source temperature is the variable, Outdoor air temperature (OAT), Return air temperature (RAT), or space temperature (ST), that drives the change of unit states. The unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

2. Supply Fan:

   a. The RTU will be factory supplied with a direct drive supply fan.

   b. Single Zone VAV: The supply fan will operate continuously between a specified minimum and maximum speed. The unit will modulate the supply fan between the minimum and maximum based on how near or far the control temperature (typically space or return temp) is away from setpoint.

3. Outside Air Damper Control:

   a. Proportional damper reset: The unit controller will proportionally modulate the outside air dampers open and closed as the supply fan speed changes to provide a constant volume of fresh outside air.

   b. Outdoor air monitor: The unit controller will modulate the outside air damper as required to maintain the outside air cfm setpoint as measured by the factory provided flow station (Requires Optional OA Monitor).

c. External Reset: An external 0-10 VDC or 4-20 mA signal can be wired to the unit controller to control the OA damper position by a third party.

4. Cooling:

a. Discharge Air Control: In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.

b. Cooling DAT reset: The cooling DAT setpoint may be reset by the space temp, return temp, OAT or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

5. Gas Heat:

a. The unit is provided with staged or modulating gas heat.

b. Modulating Gas Heat: The modulating gas heat will be modulated by the unit controller to maintain the heating DAT set point.

c. Heating DAT reset: The heating DAT setpoint may be reset by space, return, OAT, Network or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

6. Modulating Hot Gas Reheat:

a. The unit is provided with fully modulating, sub cooling, hot gas reheat coil. The control sequence used for dehumidification in a Rebel unit uses two separate points of control. The first point is the leaving coil temperature sensor (LCT), and the second point is the discharge air temperature sensor (DAT). During dehumidification the refrigeration circuit controls the compressor(s) to maintain the LCT setpoint (adjustable) and the reheat coil is controlled to maintain the supply air reheat setpoint. The supply air reheat setpoint changes based on the whether there is a call for both cooling and dehumidification or a call for dehumidification only. When a call for both cooling and dehumidification is made the reheat setpoint is set as the cooling DAT setpoint. During a call for dehumidification only the reheat setpoint is reset in a linear manner between two endpoints referred to as the min and max reheat setpoints (adjustable). This reset is based on the cooling and heating setpoints for the RTU. This logic will send warmer supply air when the space is approaching the heating changeover setpoint and cooler supply air when the space is approaching cooling changeover setpoint. This logic prevents unnecessary fluctuations between cooling and heating states.

b. Relative Humidity Dehumidification will be activated when the relative humidity in the return duct, space, or outdoor air rises above the dehumidification set point.

c. The option for dew point dehumidification uses a relative humidity sensor. The user must define the location of the sensor in the unit controller as Space, OAT, or RAT. The unit controller will reference the temperature sensor in the specified location and calculate the dew point based on that temperature and the reading from the relative humidity sensor.

7. Economizer:

a. A comparative enthalpy shall be engaged whenever the outdoor enthalpy is less than the return air enthalpy to utilize outside air for cooling. Outside air and return air dampers shall modulate to maintain supply air temperature set point.

8. Exhaust Fan Control:

a. Exhaust fans will be direct drive electrically commutated motor(s) (ECM).

b. Outdoor Air Damper Tracking: The exhaust fan(s) will activate based on the outside air damper position and will modulate between an adjustable minimum and maximum as the OA damper opens to provide relief.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

a. Start refrigeration system.
b. Do not operate below recommended low-ambient temperature.
c. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

27. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 74 13H

SECTION 23 84 13H

HUMIDIFIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following humidifiers:
   1. Steam injection.
   2. Self-contained.

1.3 DEFINITION

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, manifolds, and attachments to other work.

   1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   1. Structural members to which humidifiers will be attached.
   2. Size and location of initial access modules for acoustical tile.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Supply one replacement electrode cylinder with each self-contained humidifier.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ARI 640, "Commercial and Industrial Humidifiers."

1.9 COORDINATION

A. Coordinate location and installation of humidifiers with manifolds in ducts and air-handling units or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

PART 2 - PRODUCTS

2.1 SELF-CONTAINED HUMIDIFIERS

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. Armstrong International, Inc.
2. DRI-STEEM Humidifier Company.
3. Nortec Industries Inc.

B. Electric-Resistance Heater Container: Cleanable, ASTM A 666, Type 316 stainless steel. Comply with UL 499.
1. Tank water fill line shall incorporate an air gap.
2. Tank shall be insulated with minimum 1” elastomeric insulation.

C. Electrode Cylinder: Replaceable plastic assembly with disposable ionic bed inserts. Comply with UL 499.
1. Tank water fill line shall incorporate an air gap.
2. Tank shall be insulated with minimum 1” elastomeric insulation.

D. Gas-Fired Steam Generator: Factory assembled and tested.

1. Standard: Fabricate and label steam generator to comply with CSA.
2. Maximum Steam Pressure: 10 inches wg.
3. Burner Type: Natural-gas fired with modulating, low NOx infrared burner, minimum 82 percent efficient.
4. Gas Train: Safety shutoff valves, gas cock, strainer, pressure-regulating valve.
5. Ignition: Hot-surface ignition with flame safety system.
6. Combustion Chamber: Sealed with outdoor-air and flue-vent connections.

7. Heat-Exchanger Tank: Cleanable, ASTM A 666, Type 316 stainless steel with corrosion-resistant coating and disposable ionic bed inserts.
    a. Tank water fill line shall incorporate an air gap.
    b. Tank shall be insulated with minimum 1” elastomeric insulation.

E. Humidifier shall generate steam from or ordinary tap water.

F. Manifold: Multiple ASTM A 666, Type 316 stainless-steel tubes and separator/header extending across entire width of duct or plenum and equipped with mounting brackets on ends.

G. Cabinet: Sheet metal enclosure for housing heater cylinder, electrical wiring, components, controls, and control panel. Enclosure shall include baked-enamel finish, hinged or removable access door, and threaded outlet in bottom of cabinet for drain piping.

H. Control Panel:

1. Factory-wired disconnect switch.
2. Liquid-crystal display.
3. Programmable keyboard.
4. Set-point adjustment.
5. Warning signal indicating end of replaceable cylinder or ionic bed insert life.
6. Low-voltage, control circuit.
7. Diagnostic, maintenance, alarm, and status features.

I. Controls:

1. Microprocessor-based control system for modulating or cycling control, and start/stop and status monitoring for interface to central HVAC instrumentation and controls.
2. Solenoid-fill and automatic drain valves to maintain water level and temper hot drain water.
3. Field-adjustable timer to control drain cycle for flush duration and interval.
4. Controls shall drain tanks if no demand for humidification for more than 72 hours.
5. Monitor water level and shut gas train upon failure of fill or drain systems.
6. Terminals for
    a. Control stat
    b. Duct high-limit stat
    c. Fan interlock
7. Stainless steel conductivity-type level controls

J. Accessories:

1. Humidistat: Wall-mounting, solid-state, electronic-sensor controller capable of full modulation or cycling control.
2. Duct-mounting, high-limit humidistat.
3. Airflow switch for preventing humidifier operation without airflow.
4. Condensate tempering system.
5. Outdoor Enclosure
6. Sealed combustion kit.
7. Stack mounted thermal safety switch.
8. Vent Pipe:
    a. Category I for vertical orientation
    b. Category III for horizontal orientation.

2.2 CONDENSATE DRAIN TEMPERING TANK

A. Body and fittings shall be constructed of 304 stainless steel with welded seams.

B. Cold water supply valve shall be brass, controlled by thermostatic element.

C. Drain temperature shall be factory preset to 140°F and shall be field adjustable.

D. Unit shall have integral air gap to allow for hard piping into plumbing system.

E. Unit shall be installed horizontally and shall drain completely without using separate drain valve.

F. Overflow connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install humidifiers with required clearance for service and maintenance. Maintain path, downstream from humidifiers, clear of obstructions.

B. Seal humidifier manifold duct or plenum penetrations with flange.

C. Install humidifier manifolds in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

D. Install stainless-steel drain pan under each manifold mounted in duct.

1. Construct drain pans with connection for drain; insulated.
2. Connect to condensate trap and drainage piping.
3. Extend drain pan upstream and downstream from manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.

E. Install stainless steel duct downstream of humidifiers for a distance of 150% of the humidifier absorption length. Base of duct shall be sloped at minim 1% slope back to humidifier drain pan.

F. Equipment Mounting:

1. Install steam generators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

G. Install gas-fired steam generators according to NFPA 54.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to humidifiers to allow service and maintenance.
2. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.

B. Install electrical devices and piping specialties furnished by manufacturer but not factory mounted.

C. Install piping from safety relief valves to nearest floor drain.

D. Connect gas piping full size to steam-generator, gas-train inlet with union. Gas piping materials and specialties are specified in Section 231123 "Facility Natural-Gas Piping."

E. Connect breeching full size to steam-generator outlet. Venting materials are specified in Section 235123 "Gas Vents."

F. Connect combustion-air inlet to intake terminal using PVC piping with solvent-cemented joints. Run from boiler connection to outside and terminate adjacent to flue termination.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 CONDENSATE TEMPERING DEVICE

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install shutoff valve on cold water inlet. Hard connect condensate drain to tank inlet.

C. Install 6-inch P-trap.

D. Route overflow to nearest floor sink for atmospheric reference.

3.5 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. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 84 13H

SECTION 26 01 00

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 WORK INCLUDED

A. The specifications and drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.

B. All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of electrical system, complete, as shown on the drawings and/or specified herein. Work includes but is not necessarily limited to the following:

1. Conduits for all wiring systems, unless otherwise specifically noted.
2. All electrical wiring and connections to equipment furnished under other sections of Specifications.
3. All electrical wiring and connections to Owner furnished equipment.
4. Pull wires in conduit runs indicated as conduit only (CO).
5. Lighting panelboards.
6. Building electrical wiring, conduits, outlet boxes, junction boxes, convenience outlets, switches, plates and all miscellaneous items of electrical equipment, apparatus and material specified and/or shown on Drawings.
7. All required grounds.
8. All anchors, chases, sleeves and supports for electrical equipment.
9. Required backing, supports and blocking for lighting fixtures.
10. Relocation of Fire Alarm and Detection System.
11. Tests of entire system.
12. Lighting fixtures complete with lamps and required accessories.
13. Guarantees.
14. Temporary power for building construction.
15. Temporary lighting during construction.
16. Complete connections to all motors, apparatus, electrically operated devices, etc., as shown on Drawings.
17. Circuits, switches, starters and connections for all exhaust fans, blowers and heaters.

18. Shop Drawings.
19. Include an allowance of $250.00 for the material cost of any lighting fixture where an outlet is shown on drawings without a fixture type designation.
20. In these specifications, Fire Alarm is referred to as Auxiliary Systems or Signal Systems.

1.3 GUARANTEE

A. In addition to guarantee required in Division 01 or specifically specified elsewhere, all materials and equipment provided and installed under this Division of Specifications shall be guaranteed by Contractor in writing for a period of one year from date of acceptance of work by Owner. Should any trouble develop during this period due to defective materials or faulty workmanship, the Contractor shall furnish all necessary labor and materials to correct the trouble without costs to Owner.

B. Guarantee complete and perfect operation of entire system and that all apparatus will perform in accordance with detailed drawings and Specifications.

C. Guarantee that all equipment will be supported in such a way as to be free from objectionable vibration and noise.

D. Guarantee that all licenses and royalties for use of any patented feature of system will be paid before acceptance of system.

1.4 GENERAL REQUIREMENTS

A. Codes: Construct project in accordance with following codes and regulations.
1. 2019 California Electrical Code, Title 24 C.C.R.
2. 2019 California Mechanical Code, Title 24 C.C.R.
3. 2019 California Plumbing Code, Title 24 C.C.R.
4. 2019 California Energy Code, Title 24 C.C.R.
5. 2019 California Historical Building Code, Title 24 C.C.R.
6. 2019 California Fire Code, Title 24 C.C.R.
7. 2019 California Existing Building Code, Title 24 C.C.R.
8. 2019 California Green Building Standards Code (CALGreen Code), Title 24 C.C.R.
9. 2019 California Referenced Standards Code, Title 24 C.C.R.
10. Local codes and ordinances.
11. Division of State Architect.

Keep a copy of applicable code available at Site while performing work of this Section. Nothing in these Drawings and Specifications to be construed as authority to violate codes and ordinances. Conflict with applicable regulations to be resolved at Contractor's expense before installation.

B. Permits, Fees and Inspections: Obtain and pay for all necessary permits and fees required by any constituted authority having jurisdiction including utilities. Arrange and

pay for all required inspections or examinations and deliver certificates of inspection to Architect.

C. Record Drawings:

1. Provide record drawings for work of this Section.
2. Keep up-to-date a complete "As-Built" record set of blueline prints corrected daily and showing every change from original Drawings and Specifications and exact "As-Built" locations, sizes, and kinds of equipment.
3. Prints for this purpose may be obtained from Architect at cost of printing. Keep this set of Drawings on job and use only as a record set.
4. Drawings to serve as work progress sheets. Make neat and legible notations in red ink thereon daily as work proceeds, showing work as actually installed. Drawings to be available at all times for inspection, and kept at a location designated by Architect.
5. On completion of work, obtain one set of prints from Architect at cost of printing, and note neatly in scale all changes on record set. Deliver complete set of prints together with one set of blueline prints to Architect together with Contractor's name, address and phone number. Incorrect, non-legible or non-reproducible drawings will not be accepted.

D. Selection and Ordering of Equipment and Materials: Within two weeks after award of Contract, arrange for purchase and delivery of all light fixtures, equipment and materials required in ample quantities and at proper time. Inform Architect immediately of any inability to obtain suitable delivery of any equipment or material. Send copy of letter verifying date of purchases to Architect.

E. Shop Drawings and Material Lists:

1. Submit material lists and shop drawings as called for in Division 01, and as supplemented by this Division, and with sufficient promptness to ensure that overall work of project will not be delayed.
2. Submit six copies of a list of materials and equipment manufacturers that Contractor intends to use.
3. Provide shop drawings for following:
    a. Lighting fixtures, lamps and necessary accessories.
    b. Boxes
    c. Conduits
    d. Wires
    e. Occupancy Sensors
    f. Wall dimmers
4. Do not fabricate work until reviewed shop drawings for work have been received from Architect. Work fabricated or erected in advance of reviewed shop drawings will be at risk of Contractor.
5. Architect's or Engineer's review of shop drawings does not relieve Contractor of responsibility for errors including details, dimensions, or materials, as well as conformance with requirements of Drawings and Specifications.

6. Shop drawings will be checked by Architect and Engineer for conformance to design as a convenience to Contractor. Dimensions will not be checked. Should interferences become evident, notify Architect immediately so that matter may be resolved prior to proceeding with fabrication.
7. No reimbursement based on a claim that work was placed in accordance with dimensions shown on a reviewed shop drawing will be allowed for removing or replacing work already in place.
8. Make available a copy of every reviewed shop drawing at Project Site.
9. Submit shop drawings in coherent groups; e.g., all lighting fixtures at one time.
10. Submit actual samples of specified equipment or material to Architect for review when requested.

F. Substitution and Approval of Material:
1. Base all bids and proposals only upon materials, construction and equipment named or described in specification and/or shown on drawing. Should a Contractor wish to use other equipment than that specified, he shall submit proposed substitution by fully describing equipment he prefers to use and by listing credit or additional cost to his bid as a separate item should substitution be acceptable.
2. All equipment and materials proposed for substitution shall be similar in design and equal in quality and function to those specified herein or on drawings. Contractor (not sales vendor) shall demonstrate his proposed substitution and shall specifically note all differences between item specified and proposed substitution. Actual samples and test data, certified by an independent testing laboratory, shall be submitted when requested.
3. Each substitution will be given consideration, but without any obligation expressed or implied on part of Architect to change named requirements of specification. Only one substitution for each item of equipment will be permitted. Contractor assumes sole responsibility for performance and space requirements for substitute equipment. Decision of Architect shall be final as to whether or not substitution is acceptable.

G. Terminology:
1. Term "provide" used on Drawings and elsewhere in the Specifications shall be considered to mean "furnish and install".
2. Term "UL" means Underwriters Laboratories Inc.

H. Workmanship: See supplementary Conditions, Architect is sole judge of whether execution is in a workmanlike manner.

I. Safety Conditions: Be responsible in preventing energized switches, circuit breakers or circuits from being turned to "On" position during construction period. Be responsible for damages to personnel and/or property resulting from contact with energized circuits, switches, circuit breakers, busses or other electrical apparatus. Construct all electrical work with electrical system de-energized in area. At no time permit work on equipment or apparatus with energized circuits.

J. Verification of Dimensions: All scaled and figured dimensions are approximate and are given for estimating purposes only. Before proceeding with work carefully check and verify all dimensions and sizes and assume all responsibility for fitting of materials and equipment to other parts of equipment and to structure. Where apparatus and equipment have been indicated on drawings, dimensions have been taken from typical equipment of class indicated. Carefully check drawings and see that equipment will fit into spaces provided.

K. Locations:

1. Locations of conduits, outlets, apparatus and equipment indicated on drawings are approximate only and shall be changed to meet architectural and structural conditions as required.
2. Install conduit and equipment in a manner and in locations avoiding all obstructions, preserving headroom, keeping openings and passageways clear and readily accessible for maintenance and repairs. Make changes in locations of conduit or equipment which may be necessary to accomplish this. Drawings are essentially diagrammatic to extent that many offsets, bends, special fittings and exact locations are not indicated. Examine all drawings prepared by manufacturers, suppliers and installers of all equipment including air conditioning and plumbing fixture shelving, for requirements and locations of equipment and outlets.
3. Should any structural interferences prevent installation of outlets, setting of cabinets for lighting panelboards, running of conduits, or installation of other electrical equipment at locations shown on Drawings, necessary minor deviations therefore as determined by Engineer may be permitted. In event changes in indicated locations or arrangements are necessary due to developed conditions in building's construction or rearrangement of furnishings or equipment, Owner shall be permitted to move any junction box or utility outlet a distance of 10' and such changes shall be made without extra cost providing change is ordered before work is installed. Submit an estimate of cost or credit for other changes and proceed only upon written authority of Architect.
4. Be cautioned that diagrams showing electrical connections are diagrammatic only and must not be used for obtaining lineal runs of wiring or conduit. Wiring diagrams do not necessarily show exact physical arrangement of equipment.
5. Locations of outlets, lighting fixtures, cabinets, panelboards, apparatus, motors, mechanical equipment, etc., shown on Electrical Drawings is only approximate. Do not scale them from Electrical Drawings.
6. Verify locations of outlets, lighting fixtures, equipment etc., with Architectural Drawings of interior and exterior details and finish, and coordinate location of electrical work with mechanical and other equipment.
7. Locate lighting fixtures as per reflected ceiling plans prepared by Architect.

L. These Specifications and attendant Drawings are intended to cover a complete and operable electrical system. Follow Drawings and Specifications and execute all work according to true intent and meaning. Should any error or omission exist in either or both of these Drawings and Specifications, or conflict one with another, have same explained and adjusted by Engineer before submitting bid price for electrical work; otherwise at own expense, supply proper materials and labor to completely install same,

make good any damage to or defect in work of results obtained therefore caused by such error, omission or conflict. Most restrictive, greater quantity or size, better quality or other superior condition of all representations shall prevail. It is intended that outlets be located symmetrical with Architectural elements notwithstanding fact that locations indicated on Drawings may be distorted for clarity.

M. Omission of expressed reference in Drawings or Specifications to any item of labor or material necessary for proper execution of work in accordance with present good practice of trade will not relieve Contractor from providing such additional labor and materials.

N. Job Visits by Engineer: Periodic visits to job by Engineer is for express purpose of verifying compliance by Contractor with contract documents. Such visits by Engineer shall not be construed as construction supervision. Neither shall such visits be construed to make Engineer responsible for providing a safe place for performance of work by Contractor or Contractor's employees or safety of supplies of Contractor or his subcontractors.

O. Cooperation with Others: Organize work that will harmonize with work of all trades so that all work may proceed as expeditiously as possible. Be responsible for correct placement of work and connection of work to all related trades.

P. Protection of Finish: Provide adequate means for protecting all finished parts of materials and equipment against damage from any cause during progress of work and until acceptance by Architect. Cover all material and equipment in storage and during construction in such a manner that no finished surfaces will be damaged, marred or splattered with paint. Keep moving parts perfectly clean and dry. No paint spraying will be permitted in building. Replace or refinish damaged material or equipment including face plates or panels without additional costs to Owner.

Q. Cleaning Equipment and Premises: Thoroughly clean all parts of materials, equipment and exposed parts such as receptacles and panelboards, of cement, plaster and other materials. Remove all oil and grease spots with a non-inflammable cleaning solvent. Brush exposed metal work with steel brushes to remove rust and other spots and leave smooth and clean. During progress of work, carefully clean up and leave premises and all portions of building free from debris. At completion of work, remove all waste materials and debris resulting, leaving everything in a complete and satisfactory condition.

R. Cutting and Patching: Include all cutting and patching in bid. Do not cut any structural members without first having received written permission from Architect. Cutting of round openings which can be done by use of a rotary drill shall be done by Contractor requiring same. Cutting and patching finish work shall be performed by workmen of the respective trade.

S. Conditions at Site: Visit Job Site and become familiar with all existing conditions within scope of work and include in Bid Proposal allowance for these conditions. Verify exact locations of services prior to construction. Notify all other Contractors of these utility locations.

T. Documents: Read all relevant documents, become familiar with job, scope of work, type of general construction, Architectural, Structural, Mechanical and Electrical Drawings and Specifications. Also become familiar with purpose for which these Drawings have been prepared and become cognizant of all details involved.

U. Acceptance: Before work will be accepted, demonstrate to Owner and Architect that entire installation is complete and in proper operating condition and Contract has been fully and properly executed. Following items shall be prepared and submitted to Architect:

1. Two copies of all test results required under this Division.
2. Two copies of local and/or state code enforcing authorities final inspection certificates.
3. Copies of as-built record drawings as required.
4. Notify Architect in writing when installation is complete and that a final inspection of this work can be performed. In event defects or deficiencies are found during this final inspection they shall be corrected to satisfaction of Architect before final acceptance can be issued.
5. Two Maintenance and Operating Manuals as required.

V. Field Inspections: Provide proper facilities for access of Owner or Owner's representative to conveniently examine and inspect all portions of work covered in this Contract at any and all reasonable hours.

W. Completing Work: At completion of work, remove all waste materials and debris resulting from work, leaving everything in a complete and satisfactory condition.

X. Electrical Superintendent: Include services of a qualified electrical foreman capable of interpreting intent of Drawings and Specifications, to study Plans, Specifications and references, and coordinate all requirements with other trades, authorized to make decisions and issue instructions; be constantly in charge of work and available at job site at all times and at final inspection. Instruct Owner's representative for proper operation and recommend maintenance of all systems.

Y. Maintenance and Operating Manuals:

1. Before completion and acceptance of work, furnish Owner with two complete sets of operating and maintenance instruction manuals. Bind each set in durable hardboard binder and index.
2. Compile data for manuals upon approval of material list and sketches so as not to delay final approval of work installed. Operating manuals to contain all pertinent data relating to electrical installation such as fixture cuts, manufacturer's approval, shop drawings, sketches, wiring diagrams and equipment operating instructions.
3. Instruct Owner's operating personnel with electrical operating procedures before work is considered complete.

Z. Extra Work or Costs to This Contractor Due to Other Contractors or Trades: Adjusted between this Contractor and offending Contractor at no extra cost to Owner. Notify Architect before such extra work is done.

AA. Tests:

1. Upon completion of work and adjustment of all equipment, all systems shall be tested under direction of Owner's representative to demonstrate that all equipment furnished and installed and/or connected under provision of these Specifications shall function electrically in manner required. All tests shall be completed prior to final inspection of project.
2. All systems shall test free from short circuits and grounds and shall be free from mechanical and electrical defects. All circuits shall be tested for proper neutral connection.
3. All instrumentation and personnel required for testing shall be furnished by Contractor.

BB. Noise Control:

1. Perform electrical work to a manner in minimize transmission of noise and preserve acoustical properties of building structure.
2. Where equipment is mounted on vibration isolators, use flexible connections to reduce transmission of noise.
3. Where conduits pass through sleeves in interior walls, floors, or ceilings, completely fill space between each conduit and its sleeve to provide an airtight seal.
4. Use glass fiber material, "Duxseal" compound, for acoustic seals.

CC. Seismic Bracing Standards: All pipes, cable trays, conduits, etc. shall be supported and braced in accordance with SMACNA “Seismic Restraint Manual, Guidelines for Mechanical Systems”, including Appendix B, “Additional Requirements for OSHPD” and “Addendum no. 1, September 2000”. Comply with CBC, where requirements are more stringent than SMACNA, including, but not limited to the following:

1. Pipes and conduit shall be braced to resist the forces prescribed in California Building Code.
2. Where possible, pipes, conduit and their connections shall be constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded, or screwed connections.) Pipes, conduits and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material in accordance with California Building Code or SMACNA Seismic Restraint Manual.
3. Seismic restraints may be omitted for the following conditions:
   a. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the structural support for the hanger.
   b. All electrical conduit less than 2.5 inches trade size.
4. For rigidly supported, electrical conduit, or cable trays, the product of $C_a I_p$ need not to exceed 1.2 for any value of I_p.
5. All Trapeze assemblies supporting, cable trays and conduit shall be braced to resist the forces and relative displacements per ASCE 7 Chapter 13, considering the total weight of the elements on the trapeze.
6. Conduit supported by a trapeze where none of these elements would individually be braced need not be braced if connection to the pipe/conduit of directional

changes do not restrict movement of the trapeze. If this flexibility is not provided, bracing will be required when the aggregate weight of the pipes and conduit exceed 10 pounds/foot. The weight shall be determined assuming all pipes and conduits are filled with water.

DD. Bracing Standards Application: Comply with bracing standards by evaluating the complete installation of all utilities and equipment, and providing a comprehensive solution based on Contractor's layout, coordination withal other trades, and with the structural design and all other provisions for incorporating systems into the buildings. Show bracing products and layout in shop drawing submittals. The following criteria apply to the bracing of all systems:

1. The design parameters for determining the Total Design Lateral Force shall be as designated on the structural drawing.
2. Seismic Hazard Levels (SHL) shall be as designated on structural drawings.
3. Contractor shall submit documentation for each condition, which is not specifically covered in the SMACNA manual, including piping configurations and conditions, structural systems, structural connection methods, and other issues regarding the application of the standards.
4. Provide expansion anchors, sized per SMACNA guidelines, for use in concrete.
5. For connections to structural steel, wood framing, etc. provide bolted or welded connections, sized per SMACNA guidelines.
6. Seismic bracing components consisting of structural shapes.
7. Seismic bracing cable shall be galvanized steel, conforming to ASTM A603, zinc-coated with minimum 0.4 ounces/sf, pre-stretched, 7 x 19 strand, sized per SMACNA guidelines.

EE. In hard ceiling space where access to j-boxes, detectors, etc is required, provide ceiling access panel, fire-rated typical.

SECTION 26 01 60

ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

A. Work includes but is not limited to the following:

1. Electrical demolition.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that abandoned wiring and equipment serve only abandoned facilities.

B. Drawings are based on field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.

C. Beginning of demolition means installer accepts existing conditions.

3.2 DEMOLITION

A. Provide all necessary electrical demolition. See Architectural drawings for extent of wall removal and other demolition. Remove existing electrical devices in walls to be demolished. Re-route and reconnect as required, any active circuits feeding through these walls in order to keep upstream and downstream circuits active. Remove exposed conduit, wiring, devices, etc. as required.

B. Where new lighting is shown in an area with existing lighting, demolish existing lights, associated conduits, wires, devices, etc. Dispose of existing ballasts with PCB in accordance with all regulations of all governing agencies having jurisdiction.

C Where mechanical equipment is to be demolished as shown on mechanical drawings, demolish disconnect switches, conduits, wires and associated electrical equipment.

D. Dispose of all demolished equipment and devices. Equipment with salvage value shall be disposed of per District's instructions.

END OF SECTION 26 01 60

SECTION 26 05 19

WIRE AND CABLE-RATED 600 VOLT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

A. Work includes but is not limited to the following:
   1. Building wire.
   2. Ground Conductors.
   3. Wiring connections and terminations.
   4. Conductor Identification.

B. Related Work:
   1. Section 260100 - Basic Materials and Methods.
   2. Section 260533 - Conduit.
   3. Section 260553 - Electrical Identification.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at 90 degrees C. maximum continuous conductor temperature in dry locations, and 75 degrees C. in wet locations and shall be listed by UL Standard 83 for thermoplastic insulated wires, listed by Underwriter's Laboratories (UL) for installation in accordance with Article 310 of the California Electrical Code (CEC). Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors. Conductors shall be insulated with PVC and sheathed with nylon. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted. Wires shall be tested in accordance with the requirements of UL standard for types THWN, or THHN.

B. Conductors shall be solid Class B or stranded Class C, annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

C. Control Circuits: Copper, stranded conductor 600 volt insulation, THWN/THHN.

D. Minimum branch circuit wiring: No. 12 AWG copper, 600 volt insulation.

E. Minimum wire size except for control wiring: No. 14 AWG copper, 600 volt insulation.

F. Wiring for fluorescent lighting fixtures mounted end-to-End: Type “THHN”.

2.2 GROUND CONDUCTORS

A. Equipment ground: Insulated conductor green in color.

B. Ground Wires: Bare copper or with green colored insulation.

2.3 CONDUCTOR ARRANGEMENT AND IDENTIFICATION

A. Ties: T & B "Ty-rap" or 3M Company.

B. Lacing: Nylon twine.

C. Markers: Adhesive type, Brady.

2.4 CONDUCTORS

A. All Wire: New and delivered to job site in unbroken packages.

B. Each package shall bear Underwriter's and Manufacturer's labels and seals indicating date of manufacture and maximum allowable voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.

B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer’s recommended values

C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.

D. Pressure cable connectors, pre-insulated 3M Scotchlok, Hubbell Power, O-Z/Gedney or equal, Y, R or B spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems; except public address and telephone systems.

E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.

F. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.

I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.

J. Maintain the conductor required bending radius.

K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.

L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.

M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.

1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.

    a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the

requirements stated by the National Institute of Standards and Technology (NIST).

b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.

c. Test reports shall include the following:

1) Identification of the testing organization.

2) Equipment identification.

3) Ambient conditions.

4) Identification of the testing technician.

5) Summary of project.

6) Description of equipment being tested.

7) Description of tests.

8) Test results.

9) Analysis, interpretation and recommendations.

3.2 COLOR CODES

A. General Wiring:

1. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

2. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.

B. Signal Systems: Wires for signal systems shall be color-coded. Except where otherwise specified, color-coding shall be as follows:

SYSTEM	COLOR CODE
Clocks	Pink, Gray and Orange
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power	Brown (+) and White (-)

(4 wire smoke detectors, duct detectors)	Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

3.3 FEEDER IDENTIFICATION

A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.4 TAPE AND SPLICE KITS

A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.5 PROTECTION

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

3.6 CLEANUP

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

END OF SECTION 26 05 19

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SECTION 26 05 19H

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Metal-clad cable, Type MC, rated 600 V or less.
   3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
   1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS
   1. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.
10. WESCO.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:
1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Ground Conductor: Bare or Insulated.

F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

G. Armor: Steel, interlocked.

H. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. ILSCO.
6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
2. Type: Two hole with long barrels.
3. Termination: Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

F. .

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 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."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. Perform each of the following visual and electrical tests:
      a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
      b. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
         3) Thermographic survey.
      c. Inspect compression-applied connectors for correct cable match and indentation.
      d. Inspect for correct identification.
      e. Inspect cable jacket and condition.
      f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
      g. Continuity test on each conductor and cable.
      h. Uniform resistance of parallel conductors.
   3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
      a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19H

SECTION 26 05 23H

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Category 6a balanced twisted pair cable.
2. Balanced twisted pair cabling hardware.
3. RS-485 cabling.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CATEGORY 6a BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Belden.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.

C. Standard: Comply with TIA-568-C.2 for Category 6a cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Shielded twisted pairs (FTP).

F. Cable Rating: Plenum.

G. Jacket: White thermoplastic.

2.3 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.

4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corporation.
2. General Cable; Prysmian Group North America.
3. Service Wire Co.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.5 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
2. Outlet boxes for cables shall be no smaller than 4 inches (102 mm) square by 2-1/8 inches (53 mm) deep with extension ring sized to bring edge of ring to within 1/8 inch (3.1 mm) of the finished wall surface.
3. Flexible metal conduit shall not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inches (75 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.

14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch (12 mm) at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

F. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

G. End-to-end cabling will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

END OF SECTION 26 05 23H

SECTION 26 05 29H

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Steel slotted support systems.
   2. Conduit and cable support devices.
   3. Support for conductors in vertical conduit.
   4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified Component Importance Factor: 1.5.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

   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. Allied Tube & Conduit; a part of Atkore International.
      b. B-line, an Eaton business.
      c. Thomas & Betts Corporation; A Member of the ABB Group.
      d. Unistrut; Part of Atkore International.

   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

   3. Material for Channel, Fittings, and Accessories: Galvanized steel.
   4. Channel Width: Selected for applicable load criteria.
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

         1) B-line, an Eaton business.
         2) Hilti, Inc.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA 101
3. NECA 102.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29H

SECTION 26 05 33

CONDUIT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

A. Work includes but is not limited to the following:
   1. Rigid metal conduit and fittings.
   2. Intermediate metal conduit and fittings.
   3. Electrical metallic tubing and fittings.
   4. Flexible metal conduit and fittings.
   5. Liquidtight flexible metal conduit and fittings.

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT AND FITTINGS

A. Rigid Steel Conduit: Hot dipped galvanized inside and out, galvanized threads, mild steel, zinc coated, inside and outside protective coating. Standard lengths: 10'-0".

B. Bushings: Threaded insulated metallic type except sizes 1" and smaller may be non-metallic type. Setscrew bushings are not acceptable.

C. Couplings, elbows, bends and other fittings: Same material and finish as rigid steel conduit. All shall be threaded type.

2.2 RIGID ALUMINUM CONDUIT AND FITTINGS

A. Conduit: Extruded from 6063-T24 alloy of maximum 1/10% copper content and containing lubricating inside liners; rigid threaded type.

B. Bushings: Insulated metallic except that sizes 1" and smaller may be non-metallic.

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

A. Conduit: Galvanized steel, zinc coated, protective coating inside and out.

B. Fittings and Conduit Bodies: Use fittings and conduit bodies specified above for rigid steel conduit.

C. Conduit: May be used in lieu of rigid steel conduit where permitted by code, except in concrete, underground, runs longer than 100 feet for all power feeders with conduit greater than 2 inches.

2.4 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Conduit: Hot dipped galvanized or sherardized inside and out, zinc coated with protective enamel coating inside. Provide bushings at ends of conduits.

B. Connectors: Steel, insulated, bused tap-on or wrench tightened compression type. (Couplings similar) Indentor or screw type not acceptable.

C. Conduit: May be used in lieu of rigid steel conduit where permitted by code, except exposed, in concrete and for runs more than 100' for all power feeders with conduit greater than 2 inches.

2.5 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: Steel single strip, hot dipped galvanized on all 4 sides prior to fabrication. Flexible aluminum conduit will not be allowed.

B. Connectors: Die cast with ridges that thread into conduit. (Binding screw type connectors are not acceptable.)

C. Conduit: May be used in lieu of rigid steel conduit where specifically indicated; at connections to vibrating equipment; at drops to light fixtures from J-boxes; at locations judged by Architect impractical to use rigid conduit. Maximum length for any application shall be 6 feet.

2.6 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

A. Conduit: Steel, single strip, hot dipped galvanized on 4 sides prior to fabrication.

B. Connectors: Insulated, special Appleton "STN" Series.

C. Jacket: Liquidtight, polyvinyl chloride plastic.

D. Conduit: Use for final connection to motor terminal boxes and transformers. Use at exterior locations, damp locations, wet locations and for flex connections in kitchen, restrooms and similar areas.

2.7 CONDUIT SUPPORTS

A. Conduit Clamps, Straps, and Supports: Steel or malleable iron. Clamps: Unistrut Nos. P111 thru P1124, Kindorf No. C105. Straps: One or two hole as required.

B. Conduit hangers, racks and trapezes: Steel, threaded rods, channel iron "U" shaped racks equal to "Unistrut".

C. Individual conduit hangers: Steel, threaded rods with malleable iron split rings.

D. Hanger rods: 3/8" minimum diameter for 2" and smaller conduit, factory made. 1/2" minimum for 2-1/2" and larger conduit.

E. Wire supports: 12 gauge zinc coated iron tie wire, or 16 gauge galvanized double annealed steel tie wire.

2.8 CONDUIT PULLING CORDS

A. Pull Wire: No. 12 galvanized iron or nylon pull wire rated 250 pounds tensile strength.

2.9 CONDUIT FITTINGS, ELLS AND BUSHINGS

A. Special conduit fittings: Crouse-Hinds "Condulets" or Appleton "Unilets".

B. Ells: Same quality, same finish and same make as conduit.

C. Bushings: Thomas & Betts or approved equal.

D. Seismic separations and expansion joints: OZ type "AX" complete with bonding strap and clamps. At exterior locations use OZ type "EX".

2.10 CONDUIT SEALS AND SEALING COMPOUND

A. Vertical seals: Crouse Hinds type "EYD" or Appleton type "SF".

B. Horizontal Seals: Crouse Hinds type "EYS" or Appleton type "ESU".

C. Sealing compound: Crouse Hinds "CHICO" or Appleton "APELCO".

D. Fireproofing Compound: Dow Corning No. 3-6548 RTV or equal by 3M Company or Nelson.

2.11 MC CABLE

A. Metal Clad (MC) cable system is not allowed.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. Arrange conduit to maintain headroom and present a neat appearance.

B. Unless indicated otherwise, conceal conduit within or behind finished walls and ceiling.

C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

D. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.

F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

H. Do not support conduit from any equipment subject to vibration. Support from structural members only.

I. Structural Considerations for Conduit Routing:

1. Where conduits are to pass through or will 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, to accommodate the electrical work, such work shall conform to State Building Code.
2. Where conduits are terminated in groups at panelboards, switchboards and signal cabinets, etc., provide templates or spacers to hold conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall enter cabinets in following approved locations only: Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered 2" from rear of cabinet; conduits entering back of cabinet shall be aligned in a single row centered 2" from top of cabinet. Conduits shall not be spaced closer than 3" on centers.
3. 1" and smaller conduits above metal lath ceilings shall be tied to ceiling channels. 1-1/4" conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory made pipe straps. Conduits in metal lath or steel stud partitions, shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5'-0" apart, shall hold conduit tight against channels and studs at point of tie and shall not bear any of weight of conduit. Tie wire shall be #16 gage galvanized double annealed steel tie wire.
4. Where auxiliary supports, saddles, brackets,, etc., are required to meet special conditions they shall be made rigid and secure before conduit is attached thereto.
5. Conduit in ceiling spaces, in stud walls and under floors shall be supported with factory made pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall hold conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or 2" x 4" headers fitted between joists or wall studs.

6. Conduits installed on exposed steel trusses and rafters shall be fastened with factory made conduit straps or clamps which shall hold conduit tight against supporting member at point of support.
7. Conduits under buildings shall be strapped with factory made conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building shall not rest on ground but shall be suspended from building or shall be buried below surface of ground. 1" and larger conduits under buildings shall be suspended with conduit hangers or racks.
8. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. Pipe ring shall be malleable iron, split and hinged, and shall securely hold conduit, or shall be springable wrought steel. Rings shall be bolted to or interlocked with suspension rod socket. Rods shall be 3/8" for 2" conduit hangers and smaller and shall be 1/2" for 2-1/2" conduit hangers and larger.
9. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapezed type and shall consist of a cross channel, Steel City Kindorf #B-900, Unistrut #P-1000 suspended with a 3/8" minimum diameter steel rod at each end. Each rod shall be fastened with nuts, top and bottom to cross channel and with a square washer on top of channel. Each conduit shall be clamped to top for cross channel with conduit clamps, Steel City Kindorf #C-105 or Unistrut Nos. P-1111 through P-1124. Conduits shall not be stacked one on top of another, but a maximum of 2 tiers maybe on same rack providing an additional cross channel is installed. Where a pipe rack is to be longer than 18", or if weight it is to support exceeds 500 pounds, submit details of installation to the Architect for approval.
10. Factory-made pipe straps shall be one or 2-hole formed galvanized clamps, heavy duty type, except where otherwise specified.
11. Hangers straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is poured. Under wood use bolts, lag bolts, or lag screws; under steel joists or trusses use beam clamps.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.

B. Bring conduit to the shoulder of fittings and couplings and fasten securely.

C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Install no more than equivalent of two 90- degree bends between boxes for conduits 2" diameter and larger, three for conduit under 2" diameter. Locate pull boxes as required.

E. Use conduit bodies to make sharp changes in direction, as around beams.

F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.

G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

H. Support rigid, intermediate and thin wall conduit at 8'-0" maximum on centers and 3'-0" from junction boxes.

I. Support flexible and liquidtight flexible conduit at 4'-0" maximum on centers and 12" from junction boxes.

J. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.

K. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.

L. Where conduit penetrates fire-rated walls and floors, seal opening around conduit with UL listed fire barrier, "3M" calk or equal.

M. Do not use aluminum conduit below grade, cast in concrete or in masonry in contact with earth.

N. Cut threads on rigid conduit to standard taper and to a length such that all bare metal exposed by threading operation will be completely covered by couplings or fittings used. In addition, cut lengths of thread such that all joints will become secure and wrench tight just preceding point where conduit ends would butt together in couplings and where conduit ends would butt into ends or shoulders of other fittings. Securely tighten all threaded connections.

O. Make joints in rigid conduit installed in concrete or masonry liquid-and-gas-tight, with red lead and oil, or other approved joint compound and engage not less than five threads.

P. Keep bends and offsets in conduit runs to an absolute minimum. Replace all deformed, flattened or kinked conduit. Provide large radius factory made bends or power bend rigid metal conduit of 1-1/4" trade size or larger.

Q. Penetration Membrane: Where penetration cannot be avoided, cut and re-seal membrane at point of penetration.

R. Provide minimum 3/4" conduit size.

S. Run exposed conduit parallel with or at right angles to building line, beams, or ceilings. Place symmetrical bends or metal boxes at changes in direction or taps.

T. Stub from each panel which is flush mounted in a wall, from top of panel a minimum of 3-3/4" conduits to nearest ceiling space or other accessible locations and cap for future use. Tag to indicate panel origination.

U. Independently support conduit rising from floor for motor connections if over 24" above floor. Support shall not be a motor or duct work which may transmit vibrations.

V. Provide pull wire in all conduit runs indicated as conduit only (C.O.).

W. Do not run conduit closer than 12" to any hot water pipe, steam pipe, heater flue or vent.

X. Use rigid metal conduit where legally required, where exposed to weather, where located in unheated areas, or where subject to mechanical injury, here defined as exposed conduit less than 7'-6" above floor in areas accessible to anyone other than authorized operating or maintenance personnel.

Y. Where a conduit from one structure crosses to another structure, e.g., from a building to an arcade or from one arcade to another arcade, use a section of liquid-tight flex conduit at the crossing with sufficient slack to allow the two structures to move during an earthquake without breaking the conduit. For stub up to relocatable buildings, provide liquid-tite flex from stub up to first box on back of building.

Z. Provide a green insulated ground wire in all flexible conduit runs regardless of length.

AA. Use electrical metallic tubing above grade in dry locations only and where not subject to mechanical injury or otherwise prohibited. Concrete and masonry in contact with earth are not considered dry locations.

BB. Use liquid tight flexible conduit for final connections to motors and vibrating equipment. Use flexible conduit where required for equipment servicing for connections to recessed lighting fixtures from nearby accessible junction boxes, and for concealed runs in dry locations where structural conditions prevent use of other types of conduit.

CC. For conduits for computer cables and coax cables, use large radius bends. Do not use j-box or pull box to change direction. Install boxes at straight conduit sections only and sweep conduit to make turns. Do not use condulet fittings to change directions.

DD. Size all conduits as legally required or larger where indicated or preferred. Where portions of a conduit run are increased in size, for whatever reason, make all remaining portions in that run same size.

EE. Do not cut concrete, masonry or structural members except where approved by Architect.

SECTION 26 05 33H

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Metal conduits and fittings.
2. Metal wireways and auxiliary gutters.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.

B. Related Requirements:
1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Where raceways are crossing exposed ceiling spaces visible to the building occupants.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Allied Tube & Conduit; a part of Atkore International.

b. Electri-Flex Company.
c. FSR Inc.
d. O-Z/Gedney; a brand of Emerson Industrial Automation.
e. Thomas & Betts Corporation; A Member of the ABB Group.
f. Western Tube and Conduit Corporation.
g. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. EMT: Comply with ANSI C80.3 and UL 797.
6. FMC: Comply with UL 1; zinc-coated steel.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. AFC Cable Systems; a part of Atkore International.
b. Allied Tube & Conduit; a part of Atkore International.
c. Anamet Electrical, Inc.
d. FSR Inc.
e. O-Z/Gedney; a brand of Emerson Industrial Automation.
f. Thomas & Betts Corporation; A Member of the ABB Group.
g. Western Tube and Conduit Corporation.
h. Wheatland Tube Company.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
a. Material: Steel.
b. Type: Setscrew or compression.
7. 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.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, 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 Incorporated; Wiring Device-Kellems.
      b. MonoSystems, Inc.
      c. Panduit Corp.
      d. Wiremold / Legrand.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Crouse-Hinds, an Eaton business.
   2. Hoffman; a brand of Pentair Equipment Protection.
   3. Hubbell Incorporated.
   4. MonoSystems, Inc.
   5. Oldcastle Enclosure Solutions.
   6. O-Z/Gedney; a brand of Emerson Industrial Automation.
   7. RACO; Hubbell.
   8. Spring City Electrical Manufacturing Company.
   9. Thomas & Betts Corporation; A Member of the ABB Group.
   10. 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. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: EMT.
   3. Underground Branch Conduit: RNC, Type EPC-40-PVC, concrete encased.
   4. Underground Feeder Conduit: Type EPC-40-PVC concrete encased.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

B. Minimum Interior Raceway Size: 3/4-inch (21-mm) trade size.

C. Minimum Exterior Raceway Size: 1-1/4”inch (32-mm) 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. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install, for 70 volt and above, 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 (300 mm) of changes in direction.

I. Install, for below 70 volt raceways, no more than the equivalent of two 90-degree bends in any conduit run. Support within 12 inches (300 mm) of changes in direction.

J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

K. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

L. Support conduit within 12 inches (300 mm)of enclosures to which attached.

M. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) 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 (3-m) 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 (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

N. 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.

O. 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.

P. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Surface Raceways:
1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway

section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

W. Install raceway sealing fittings at accessible locations according to NFPA 70 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 NFPA 70.

X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Z. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   b. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   c. Attics: 135 deg F (75 deg C) 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 (0.06 mm per meter of length of straight run per deg C) 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 (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves 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."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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 26 05 33H

SECTION 26 05 34

BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

A. Work includes but is not limited to the following:
   1. Wall and ceiling outlet boxes.
   2. Pull and junction boxes.
   3. Sealant.

B. Related Work:
   1. Section 260100 - Basic Materials and Methods.
   2. Section 260533 - Conduit
   3. Section 262726 - Wiring Devices.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS-OUTLET BOXES

A. Raco

B. Steel City

C. Bowers

2.2 OUTLET BOXES

A. Sheet Metal Outlet Boxes: One piece galvanized, pressed steel, knockout type, 4-11/16" sq. by 2-1/8" deep in all locations unless otherwise indicated or required.

B. Cast Boxes: Aluminum, or Cast feralloy, deep type, gasketed cover, threaded hubs.

2.3 ACCEPTABLE MANUFACTURERS-FLOOR BOXES

A. Hubbell

B. Walker Parkersburg

C. Steel City

2.4 PULL AND JUNCTION BOXES

A. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsional and deflecting forces. Boxes shall have auxiliary angle iron framing where necessary to ensure rigidity. Covers shall be fastened to box with a sufficient number of brass machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws at Site if boxes are not installed plumb. All surfaces of pull and junction boxes and covers shall be given one coat of metal primer, and one coat of aluminum paint.

B. All junction and pull-boxes shall be rigidly fastened to the structure and shall not depend on conduits for support.

2.5 ACCEPTABLE MANUFACTURERS-SEALANT

A. Crouse Hinds "CHICO"

B. Permacel

C. Ductseal

2.6 ACCEPTABLE MANUFACTURERS - FIRE PROOFING SEALANT

A. Dow Corning

B. 3M Company

C. Nelson

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify exact location of floor boxes and outlets in offices and work areas with Owner's representative prior to rough-in.

C. Locate and install boxes to allow access.

D. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

A. Unless otherwise noted on plan or specifically allowed by the Engineer, conceal all boxes flush in wall or in ceiling space above drop ceiling. In finished areas and where it

is not possible to conceal conduits and boxes, for example, on existing concrete wall, provide Wiremold type metallic surface raceways and boxes.

B. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.

C. Provide knockout closures for unused openings.

D. Support boxes independently of conduit except for cast box that is connected to two rigid metal conduits, both supported within 12 inches of box.

E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

F. Install boxes in walls without damaging wall insulation.

G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

H. Position outlets to locate lighting fixtures as shown on reflected ceiling plans.

I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed lighting fixture, to be accessible through lighting fixture ceiling opening.

J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs. Accurately position to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes. Install plaster rings to interface with equipment to be mounted thereon.

K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

L. Where boxes are installed in fire rated ceiling or walls, be responsible for preserving integrity of fire rating as required.

M. In fire-rated wall, use 4" square deep boxes. Do not aggregate more than 100 square inches of boxes for any 100 square feet of wall or partitions. Separate outlet boxes on opposite sides of walls or partition by a minimum horizontal distance of 24 inches. Where the separation cannot be achieved due to site condition, provide 2-hour rated fire-proof material behind boxes to maintain fire rating of walls.

3.3 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

SECTION 26 05 44H

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Advance Products & Systems, Inc.
    b. Holdrite (Engineered Sleeve Solutions).
    c. 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.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. HOLDRITE.

2.4 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.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) 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 (50 mm) 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.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44H

SECTION 26 05 48H

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Restraint channel bracings.
   2. Seismic-restraint accessories.
   3. Mechanical anchor bolts.
   4. Adhesive anchor bolts.

B. Related Requirements:
   1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.
   1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
   3. 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. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:
   1. Control and monitoring panels.
   2. Panelboards.

B. Qualification Data: For testing agency.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   1. B-line, an Eaton business.
   2. Hilti, Inc.
   3. Kinetics Noise Control, Inc.
   4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to 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 caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:
   1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48.16H

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

A. Work includes but is not limited to the following:
   1. Nameplates.
   2. Wire and cable markers.

B. Related Work:
   1. Section 260100 - Basic Materials and Methods.
   2. Section 260519 - Wire and Cable -Rated 600 Volt.
   3. Section 260533 - Conduit.
   4. Section 260534 - Boxes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

B. Wire Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to outside face of panelboard doors.

D. Embossed tape will not be permitted for any application.

3.2 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

3.3 MARK CONDUCTOR RUNS

A. Apply markers after conductors installed in conduits.

B. Apply in panelboards and in junction boxes.

3.4 MARK JUNCTION BOXES

A. Mark covers of junction boxes with non-erasable marker to indicate circuit numbers or systems contained within boxes.

B. Mark fire alarm boxes with red marker and identifying as "FA".

C. Paint fire alarm conduits red at intervals such that conduits can be clearly identified for fire alarm system.

END OF SECTION 26 05 53

SECTION 26 05 53H

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Paint for identification.
8. Fasteners for labels and signs.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

C. Comply with ANSI Z535.4 for safety signs and labels.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
4. Color for Neutral: White or gray.
5. Color for Equipment Grounds: Green.
6. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

F. Equipment Identification Labels:
1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.
   b. Panduit Corp.
   c. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.
   b. Panduit Corp.
   c. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

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. Brady Corporation.
    b. Brother International Corporation.
    c. Ideal Industries, Inc.
    d. Panduit Corp.
    e. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Brother International Corporation.
    c. Ideal Industries, Inc.
    d. Marking Services, Inc.
    e. Panduit Corp.
    f. Seton Identification Products.

2. Minimum Nominal Size:
    a. 1-1/2 by 6 inches (37 by 150 mm)for raceway and conductors.
    b. 3-1/2 by 5 inches (76 by 127 mm)for equipment.
    c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

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. Brady Corporation.
    b. Marking Services, Inc.
    c. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

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. Brady Corporation.
    b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

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. Brady Corporation.
    b. Carlton Industries, LP.
    c. Marking Services, Inc.

B. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.

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. LEM Products Inc.
    b. Marking Services, Inc.
    c. Seton Identification Products.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

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. Brady Corporation.
    b. Carlton Industries, LP.
    c. Marking Services, Inc.
    d. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch (0.58 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Brady Corporation.
    b. Marking Services, Inc.

c. Panduit Corp.
d. Seton Identification Products.

C. Write-on Tags:

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. Carlton Industries, LP.
b. Seton Identification Products.

2. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlton Industries, LP.
b. Marking Services, Inc.

2. Preprinted aluminum signs,punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. Marking Services, Inc.

2. Engraved legend.
3. Thickness:
   a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
   b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ideal Industries, Inc.
2. Marking Services, Inc.
3. Panduit Corp.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

M. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

N. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

O. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

Q. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

R. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

T. Metal Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using plenum-rated cable ties.

U. Nonmetallic Preprinted Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using plenum-rated cable ties.

V. Write-on Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using plenum-rated cable ties.

W. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

X. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

Y. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

E. Equipment Identification Labels:
1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Stenciled legend 4 inches (100 mm) high.
3. Equipment to Be Labeled:
   a. Access doors and panels for concealed electrical items.
   b. Enclosed switches.
   c. Enclosed circuit breakers.
   d. Enclosed controllers.
   e. Variable-speed controllers.
   f. Push-button stations.
   g. Monitoring and control equipment.

END OF SECTION 26 05 53H

SECTION 26 05 80

AUDIO/VIDEO SYSTEMS INFRASTRUCTURE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Electrical work related to audio/video (AV) systems, as shown on Category AV drawings.
   2. Raceway systems, including conduits, boxes, cover plates and enclosures.
   3. Installation of back-boxes for ceiling-mounted loudspeakers.
   4. Special grounding conductors for electronics equipment cabinets and other AV equipment.

B. Related Sections:
   1. Electrical Basic Material and Methods provided under Division 26

C. Substitutions: Substitutions will be considered only under the terms and conditions of Division 1.

1.03 REFERENCES

A. National Electrical Code (NEC), NFPA 70

B. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.

1.04 DESCRIPTION

A. Provide raceway systems for the installation of sound reinforcement systems, audio, and video media wiring. The installation shall include raceways, outlet boxes, loudspeaker back cans, plaster rings, outlet box cover plates and terminal boards. Installation of cables and equipment is not included in this Section.

1.05 SUBMITTALS

A. Make submittals in accordance with Division 1. Submit product data and other submittals for work of this Section separately from submittals of other Sections of Division 26, to allow review by the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise specified in this Section, provide products and materials for AV infrastructure in accordance with other Sections of Division 26.

2.02 SURFACE MOUNTED RACEWAYS (SMR)

A. Provide metallic surface raceways with a connecting EMT conduit system at ceiling level to transition from EMT conduit run along ceiling to surface mounted raceway running down the wall to the receptacle.

B. Provide surface raceway systems for AV wiring. Surface raceway system shall consist of raceway bases, covers, appropriate fittings and device mounting plates necessary for a complete installation.

C. Provide full capacity corner elbows and tee fittings to maintain a controlled 2-inch cable bend radius.

D. Raceway Device Boxes:

1. Raceway Device Box shall accommodate standard gang faceplates and bezels.
2. Ensure device box will provide sufficient space for jacks, bend radius for terminations and jacks. Contractor shall provide minimum 1 ¾" depth device boxes.
3. Wiring connections shall be completed during installation.

E. Color: Black.

F. Product: Wiremold V700 Series or equal.

2.03 WIRE LABELS

A. Wire labels: Permanent cables shall be marked with wire labels at both ends of the cable. The wire labels shall utilize plastic shrink-wrap, protecting the text and ensuring they remain affixed to the wiring.

2.04 PULL WIRE

A. Shall be plastic having not less than 200-pound tensile strength.

2.05 PLATES

A. Provide blank stainless steel device plates for gang boxes. Provide blank inserts for floor boxes.

PART 3 - EXECUTION

3.01 GENERAL

A. Except as otherwise specified in this Section, comply with other Sections of Division 26 for installation of AV infrastructure.

B. Provide and install accessories as required to form complete systems for raceway and special grounding.

C. The locations of the outlet boxes and other devices shown on the Category AV drawings are approximate. Refer to the Architectural Drawings (such as wall elevations, reflected ceiling plans, dimensioned floor plans, and details) for exact locations. For devices not shown on Architectural Drawings, verify exact location with Owner prior to rough-in.

3.02 RACEWAYS

A. Conduit shall be rigid ferrous metal thin wall conduit unless otherwise designated on the Category AV drawings

B. Shall conform to Division 26 specification sections. Provide pull or junction boxes where necessary to comply with these requirements.

C. Only Owner approved intermediate junction boxes or pull boxes shall be installed. They shall be located directly above the outlet location in accessible ceiling spaces.

D. Structural Conflicts: In situations where more than 270 degrees of conduit bends are required to route around existing structural features, pull boxes may be used. Locate the first pull box directly above the outlet location so that it can be easily found. Prior approval by the Owner is required if more than one pull box is required. Locations of pull boxes shall be clearly marked on the Record Drawings.

E. Install AV system raceway to comply with NEC chapters 1-3, regardless of the class of wiring to be installed.

F. Install AV system raceway to maintain at least 24 inches of separation from conduits and wiring of power, lighting, and Class I signaling. Maintain at least 48 inches of separation from dimmed lighting circuits. Where runs are adjacent for less then 50 feet, the required spacing may be halved (12 inches, or 24 inches from dimmed lighting circuits). Where runs are adjacent for less than 6 feet, or where conduits cross at right angles, separations of 2 inches may be used.

G. Do not combine conduit runs that are shown separately on the drawings.

H. Show final routing of conduit on the Record Documents.

I. Do not use 90-degree fittings or conduit bodies in AV raceway; use pull boxes, not conduit bodies. Pull boxes shall be sized per NEC Article 314.

J. Install accessible pull boxes as required so that no conduit pull is longer than 100 feet, and that no conduit run contains more than a cumulative total of 270 degrees of bends (count each offset as 45 degrees of bending).

K. Clearly document the exact locations of pull boxes on the Record Drawings.

L. The inside radius of each conduit bend shall be in accordance with NEC Table 2 Chapter 9.

M. Provide an insulated bushing on each end of conduits, including conduit stubs.

N. Where conduits stub out to cable tray, install so that the bushing on the end of the conduit is easily accessible, and within 12 inches of the edge of the cable tray horizontally, and within 24 inches of the cable tray vertically, but does not extend over the cable tray. Do not provide a down-turning bend at the cable tray. Bond the conduit to the cable tray at the point of stub out above the tray, using a grounding wire or other approved means.

O. For raceway connected to AV equipment cabinets, use a short length of non-conductive raceway (PVC) to insulate the raceway from the cabinet. Bond the equipment cabinet to ground only via the insulated, isolated grounding conductor of the branch circuit(s) feeding the cabinet. Refer to paragraphs 250.96 (B) and 250.146(D) in Chapter 2 of the NEC.

P. The Contractor shall verify the continuity of conduit by passing a mouse through each conduit run.

3.03 PULL CORDS

A. Nylon type, shall be included in raceways. Leave not less than 12 inches of slack at each end of the pull wire.

3.04 FLOORBOXES

A. Land conduit for floor box as shown on the Category AV drawings. Provide internal barrier strips for AC Power and Data receptacles to segregate the AC from the other cable types.

3.05 SPEAKER BACK BOXES

A. Install loudspeaker back-boxes to be exactly centered in ceiling tile or building element with sides of box (or lines between fastener holes for round enclosures) exactly parallel to ceiling grid or building lines.

B. Do not support loudspeaker enclosures with lay-in tiles or GWB. Provide adequate support (using attachments to structural elements and/or metal mounting bars) for back boxes so that no perceptible sag occurs after the loudspeaker and grille are installed.

3.06 IDENTIFICATION

A. Label each conduit and other raceway at each end with the purpose (e.g. “AV”) and destination (e.g. “to Room 100”).

B. Label each outlet box, back-box, and pull box with purpose and AV plate identifier.

C. Provide labeling which is clear and permanent, such as black permanent-ink marker on conduit and stenciled painted markings on the insides of outlet box covers.

END OF SECTION 26 05 80

SECTION 26 28 16H

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Molded-case switches.
   5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

1.7 QUALITY ASSURANCE

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2010 m).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. ABB Inc.
   2. Eaton.
   3. General Electric Company.
   4. SIEMENS Industry, Inc.; Energy Management Division.
   5. Square D; by Schneider Electric.

B. Type HD, Heavy Duty:
   1. Single throw.
   2. Three pole.
   3. 600-V ac.
   4. 1200 A and smaller.
   5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
   6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 240-V ac.
2. Hookstick Handle: Allows use of a hookstick to operate the handle.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated Series rating is not allowed.

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12) [copper-free cast aluminum alloy (NEMA 250 Types 7, 9)].

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Owner's written permission.
   4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections [with the assistance of a factory-authorized service representative].

C. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.

i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
   e. Determine the following by primary current injection:
      1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
   f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
   g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
   h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
   i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.
1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 26 28 16H

SECTION 26 29 23H

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Requirements:

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.

c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Indicating Lights: Two of each type and color installed.
3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Low Voltage HVAC Drives.
2. Eaton.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc., Energy Management Division.
5. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: Constant torque and variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.

7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet (1000 m).
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 12 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Under- and overvoltage trips.
5. Inverter overcurrent trips.
6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
7. Critical frequency rejection, with three selectable, adjustable deadbands.
8. Instantaneous line-to-line and line-to-ground overcurrent trips.
9. Loss-of-phase protection.
10. Reverse-phase protection.
11. Short-circuit protection.
12. Motor-overtemperature fault.

K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

N. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
5. NO alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

   a. A minimum of two programmable analog inputs: 0- to 10-V dc.
   b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

   a. 0- to 10-V dc.
   b. 4- to 20-mA dc.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:

   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

F. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

    a. Monitoring: On-off status,.
    b. Control: On-off operation,.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.6 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Covered Shielded.
2. Pilot Lights: Push to test.
3. Selector Switches: Rotary type.
4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

D. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

H. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

I. Spare control-wiring terminal blocks; unwired.

2.8 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

C. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.

2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 26 29 23H

SECTION 26 51 00

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.2 DESCRIPTION

A. Work includes but is not limited to the following:
   1. Lighting fixtures and accessories.

B. Related Work:
   1. Section 260100 - Basic Materials and Methods.
   2. Section 260519 - Wire and Cable.
   3. Section 260529 - Supporting Devices.
   4. Section 260533 - Conduit.
   5. Section 260534 - Boxes.

1.3 SUBMITTALS

A. Submit Shop Drawings.

B. Include outline drawings, lamp and ballast data, support points, weights, and accessory information for each lighting fixture type.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - LIGHTING FIXTURES

A. See Lighting Fixture Schedule on drawings.

2.2 SWITCHING AND DIMMING CONTROLS

A. General
   1. All devices color per architect.
   2. Observe manufacturers installation instructions with particular attention to derating requirements for multiple gang installations.
   3. Use factory made multiple gang faceplates matching device color.
   4. Daylight Controls may be integrated into luminaires Performance shall equal or exceed specification for individual devices.

B. Switches

1. Standard snap style
2. 120/277 volt, 20A
3. Listed
4. Specification grade
5. Color per architect

C. Automatic control switch

1. Automatic control switch shall be a push button wall switch capable of on/off manual operation and shall also be capable of receiving automatic control signals through interrupting power to the switch and load.
2. Control switch shall mount in a standard single gang or multi-gang wall box and shall fit behind a decorator style face plate.
3. Control switch shall use an air gap relay rated for 15 Amp ballast, tungsten, general use and shall be compatible with all electronic ballasts and HID loads.
4. The control switch when used with an occupancy sensor shall provide manual on/off control from the push button and automatic shut off based on occupancy. When occupancy is not detected and the sensor's time delay has expired, the lights shall turn off. If occupancy is detected within 15 seconds of this shut off, the switch shall turn the lights back on. Otherwise, lights will remain off until the switch is manually turned on.
5. Control switch shall be capable of 3-way, 4-way, or multi-way switching.
6. Control switch shall be The Watt Shopper AS-100 or Sentry Switch or approved equal.

D. Motion sensors

1. Provide a dual technology sensor that detects presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
2. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
3. Sensor shall be mounted and adjusted in order to eliminate detection through open doorways and outside of controlled area. To provide small motion diction and immediate activation upon entry, coverage of both technologies must be complete and overlapping throughout the controlled area.
4. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material. The lens shall cover up to 2000 square feet for walking motion when mounted at 10 feet and 1000 square feet of desktop motion.
5. Ceiling or high wall mounted. Coordinate location for best detection when used with suspended lighting.

6. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall automatically adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
7. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 5 to 30 minutes, set by DIP switches.

E. Automatic daylighting switches
1. Provide an ON/OFF daylight controller to reduce the controlled lighting as the daylight level increases. Where two stages of reduction are specified, provide a two stage controller providing a sequence reduction. As an alternate, two single stage controllers may be provided to provide two stages of reduction as long as these two devices may be adjusted to provide the desired sequencing of the lighting reduction and maintain this sequencing when switching the lights off and again when switching the lights on.
2. Ceiling mounted or luminaire mounted. The function of the automatic daylighting switches shall not be provided by a wall switch or a device mounted at wall switch height. If the device s powered by line voltage then it must be enclosed in an enclosure rated a minimum of NEMA 1 with a tamper proof cover or locking cover.
3. Independently adjustable setpoint and deadband. Setpoint shall be adjustable from at least 10 footcandles up to100 footcandles. Deadband shall be adjustable up to at least 100% setpoint.
4. Adjustable time delay. Lighting level must be above the off setpoint continuously for the length of the time delay before the lights will switch off. The device shall not have a length of the time delay shorter than 3 minutes. Time delay shall be adjustable to up to 20 minutes.
5. Low voltage device to be connected by low voltage wiring to a power pack. If control sequence can be met, one power pack may be used with multiple control devices.
6. Daylight switch shall provide visible indicator of the current status of the control output. Indicator shall be an LED.
7. Daylight switch to provide a test mode that temporarily bypasses the time delays. If left in test mode, the daylight switch will automatically resume normal time delays at the end of a period no longer than 60 minutes. (This item is a requirement of the 2005 Title 24 standard).

F. Automatic daylighting dimming systems
1. Provide a daylighting controller to continuously dim the fluorescent lights. Daylighting controller may be a self contained photosensor or a controller with a remote photocell. Photocell or photosensor are to be ceiling mounted or attached to a pendant fixture.
2. Photosensor to provide 0 – 10 V dimming signal to continuously dim the ballasts proprietary methods of signaling dimming ballasts shall be acceptable.
3. Daylighting controller may be open or closed loop type. Closed loop devices may not be used in applications where there are adjoining dimming zones such that the luminaires from one dimming zone can be viewed by the daylighting controls in another zone. All daylighting controllers shall provide proportional control. An open loop device may accomplish this with one adjustment. All closed loop

devices shall have at least two adjustments to provide an adjustable response. Any device which attempts to maintain a constant photocell signal shall not be acceptable.

4. All adjustments shall be adjustable from the photocell.
5. Provide an occupant adjustment or override wall switch to allow the teacher to adjust the light levels.
6. Approved sensor/control manufacturers: Wattstopper, Lutron, Leviton, Lithonia, Novitas, Douglas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lamps in lighting fixtures and lampholders.

B. Support surface-mounted lighting fixtures directly from building structure. Provide additional blocking, unistruts, steel channels, etc. as required.

C. Install recessed lighting fixtures with attached accessible junctions boxes to permit removal and access from below. Use plaster frames in plaster , gypsum wallboard or acoustic ceilings. In grid ceiling rated for light fixture support, support recessed fluorescent light fixtures directly from T-bar using approved earthquake clips and in addition, 2 No. 12 wires (slack wires), one at each diagonal end of fixture attached directly to a structural member. If two opposite ends of a fixture do not rest on ceiling main runners, provide 4 No. 12 wires (support wires) to structural member. In grid ceiling not rated for fixture support, attach fixture to grid using approved earthquake clips and in addition 4 No. 12 support wires directly to structural member.

D. Provide safety chain between fixture and structure for recessed light fixtures. Mount hanger channels to span structural and/or T-bar ceilings.

E. Provide required backing for all lighting fixtures.

F. Join continuously mounted fixtures by use of chase nipples.

G. Provide spacers where required.

H. Mount light fixtures so that fixture labels are not visible when viewed from below.

I. For recessed fixtures in fire rated ceiling, provide fireproofing enclosure equal to rating of ceiling.

J. Test motion sensors and daylighting controls.

K. For all dimming systems, contractor is responsible for burning in all lamps for 100 hours. Lamps are to operate at full output for this period.

L. Contractor is responsible for setting up and adjusting all control devices per the manufacturer's adjustments and resulting performance.

3.2 TESTS

A. Immediately before turning completed job over to Owner, clean all light fixtures inside and out, including plastics and glassware, adjust and tighten all trim, replace broken or damaged parts, lamp and test fixtures for electrical and mechanical operation. Replace all inoperative lamps, ballasts and other inoperative equipment.

B. Replace noisy ballasts immediately.

C. **Include in bid the service of a California Registered Professional Engineer or a Professional recognized by the State of California to review and certify the final installed lighting control system as required by the California Energy Code (Title-24). The Professional shall sign the required documents, submit to the proper agency and be responsible for certifying the installed lighting control system.**

SECTION 27 41 00

AUDIO/VIDEO SYSTEMS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

A. The General Conditions of the Contract and Instruction to Bidders including Supplementary Conditions apply to Work under this section.

B. The Contractor acknowledges and warrants that the Contract Documents have been closely examined, that the Contract Documents are suitable and sufficient to enable the Contractor to complete the Work in the time allotted for the Contract Sum as accepted by the Owner and that the Contract Documents imply Work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the Work in full compliance with applicable codes, laws, ordinances, rules, and regulations.

C. Execution of the Contract by the Contractor is a representation and warranty that the Contractor has carefully examined the Contract Documents, and that the Contractor is thoroughly familiar with the nature and location of the Work, the Site, the specific conditions under which the Work is to be performed, and matters which may in any way affect the Work or its performance. The Contractor further represents that as a result of such examinations and investigations, the Contractor has thoroughly reviewed and understands the Contract Documents and their intent and purpose, and is familiar with applicable codes, ordinances, laws, regulations and rules as they apply to the Work, and that the Contractor shall abide by same.

D. Claims for additional time or additional compensation as a result of the Contractor's failure to thoroughly review and understand the Contract Documents and be familiar with local conditions and the Contract Documents shall not be permitted.

E. Related Work Specified Elsewhere:

1. AC Power provided under Division 26.
2. AV System infrastructure including raceways including conduits, boxes, cover plates cable trays, enclosures, terminal cabinets and loudspeaker back-boxes provided under Division 26.
3. Category AV drawings.

1.02 SUMMARY OF WORK

A. Conference Center: The Conference Center will be used for meetings, presentations and film screenings. The AV system will include the following components:

1. Sound System: a sound reinforcement system for program audio playback and speech reinforcement. This will consist of distributed ceiling loudspeakers for speech reinforcement and a stereo pair of loudspeakers for program audio. The sound system will include two channels of wireless microphones and hardwired microphone inputs at the front of the room.
2. Projection: A video projector and electric roll down screen will be provided at the front of the room for presentations and movies. Video sources will include a Blu-ray player and TV tuner. A wireless network interface will be provided to allow users to project an

image via the dedicated wireless access point in the room. There will also be an input for portable video and computer equipment at the front of the room.

3. Remote Control: A remote control system will be provided to control the AV system functions via a rack mounted touch panel.
4. Hearing Assistance: An ADA compliant hearing assistance system will be provided to support the sound system. This system will consist of an RF transmission system and a pool of receivers for audience members.

B. Entry: The existing Entry AV system will be upgraded to improve function and increase functionality.

1. Hearing Assistance System: Provide a hearing assistance system for the Entry. The hearing assistance system will use RF transmission.
2. Sound System:
   a. Audio Processor: Provide a new audio processor.
   b. Main Loudspeakers: Re-aim the stereo loudspeakers so that they best match the coverage area to the audience area. Adjust the control settings on the loudspeakers and other system components to optimize the frequency response of the outputs. Provide new wiring between the amplifier and the loudspeakers to improve the loudspeaker performance.
   c. Satellite loudspeakers: Relocate and re-aim the satellite loudspeakers to minimize overlap with the coverage of the Main loudspeakers. Adjust the programming of the audio processor to optimize the frequency response and delay for the satellite loudspeakers. Modify the programming so satellite loudspeakers receive the same input signal consisting of a monaural mix of the audio signals.
3. Video Projection:
   a. Video Switcher: Provide a video distribution system to add a computer input and camera input in the Entry adjacent to the lecturer's position.
   b. Cabling: As part of the replacement of the Video Switcher we will specify replacement of the cabling for the video distribution system.
   c. Network Interface: We will specify an interface that will allow connection of a computer to the system wirelessly via the AV system wireless access point.
4. Remote Control System: Provide a touch panel at the equipment rack to provide control of the AV system. Provide an emulation of the touch panel on an OFE iPad.
5. Overflow to the Conference Center: Provide the Entry video and audio signal to the Conference Center.
6. IMAG Camera: Provide a portable camera to project a close up of a lecturer on the projection screen. A dedicated input for the camera will be provided.
7. Audio Source Equipment: Provide Media player for use with the portable mixing console.

C. Scope:

1. Provide sound and video systems including apparatus and equipment, wiring, termination, labor, and services required to provide systems as specified and shown on the Category AV Drawings.
2. Provide any incidental equipment needed in order to meet the functional requirements stated herein and on the Category AV Drawings. This shall include support and restraint for fixed equipment, including loudspeakers and projection equipment.

3. Set up and adjustment of specified hardware and software.
4. Furnish test equipment and the services of the project engineer and the project manager to assist the Owner's Representative in onsite observations.
5. Make any adjustments to any part of the system, including the re-aiming of loudspeakers, which may be found necessary during the acceptance observation.
6. Provide a total of 8 hours of training in the operation of the systems to the person or persons selected by the Owner. Videotape training sessions and provide 3 copies edited on DVD format to the Owner.

D. Coordination:
1. Schedule installation operations in sequence required to obtain the best completion results.
2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

E. Coordinate specialty sub-Contracting including installation of telecommunications lines and equipment as shown on the Contract Documents.

1.03 EQUIPMENT AND MATERIALS

A. Verify that characteristics of interrelated equipment and components are compatible.

B. Coordinate work having interdependent responsibilities for installing, connecting to, and placing in service system components and equipment.

C. Requests for Substitutions:
1. The Contractor shall represent that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior to the specified product.
2. The Contractor shall represent that the warranty for the substitution is equal to or greater than to warranty provided for the specified product.
3. The Contractor shall certify that the cost data presented in conjunction with the proposed substitution is complete and includes related costs under this Contract, and waives claims for additional costs related to the substitution which may later become apparent.
4. The Contractor shall coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete including, but not limited to, in full compliance with applicable codes, laws, ordinances, rules, and regulations and completion in the time allotted for the Contract Sum as accepted by the Owner and Consultant.
5. If a requested substitution requires a change in the engineering of the system the Contractor shall submit applicable design revisions as part of the substitution request.
6. The Consultant shall be the final judge of the acceptability of substitutions.

1.04 SCHEDULE

A. Within ten calendar days of the receipt of the notice to proceed the Contractor shall prepare and submit for approval, in accordance with the Contract, a schedule which shall include, but is not limited to, the following:

1. Submission dates for submittal packages:
    a. Field and Shop Drawings Submittal
    b. As-built Drawings
2. Start and Completion date(s) for shop fabrication work.
3. Completion Dates for programming of remote control system and DSP driven devices.
4. Start and Completion date(s) for field installation work.
    a. Installation dates of wires and cables in conduits and required cable trays.
    b. Delivery dates of systems and subsystems to the project site.
5. Completion dates for the following tests:
    a. Performance tests on individual A/V components as they are received from the manufacturer in the Contractor's shop.
    b. Performance tests on completed assemblies and subassemblies assemblies, including racks in the Contractor's shop.
    c. Performance tests on the completed systems as a whole prior to shipment to the project site.
    d. General performance testing of systems at the project site.
6. Completion dates for the following Shop and Field Observations.
    a. Shop fabricated assembly and subassembly observation.
    b. Substantial Completion Observation at the project site.
    c. Final acceptance observation at the project site.
7. Submission date for delivery of operating and maintenance manuals, as-built drawings, documentation and closeout materials.

B. In the event the Contractor wishes to deviate from the schedule once it is established and approved, he may do so only receiving written approval from the Owner.

1.05 SUBMITTALS

A. Submittals shall be in accordance with the Contract requirements.

B. Substitutions of equal equipment beyond the alternatives listed will be permitted only in accordance with the General Conditions.

C. Field and Shop Drawing Submittal: Submit the following:
1. Material listed below shall be provided in a single comprehensive package: partial or incomplete submittals will not be reviewed and will be returned to the Contractor for completion.
2. Bill of Materials and Specification Sheets: The following material shall be incorporated into a single pdf file.
    a. Review Stamp: A blank page shall be provided at the front of the pdf to accommodate the review stamp.
    b. Table of Contents: A table of contents shall be provided for the pdf file and each item identified below shall have an entry in the table of contents. Each item shall have a bookmark associated with it and the bookmark will be accessible via hyperlink in the table of contents to the actual item.

c. Statement of Contractors: A statement outlining subcontractors, franchises, distributorship, dealerships, arrangements and agreements with manufacturers of equipment to be used for this work.

d. Certifications: The Contractor shall provide the copies of the certifications noted in Article1.06, below.

e. Bill of Materials: A bill of materials shall be provided for each system within the Work. Each bill of materials shall be listed separately in the table of contents and provided with its own bookmark. Each bill of materials shall be identified by the Room number and room name. Each bill of materials shall include the material, components, devices and equipment required for the work. The Bill of Materials will be ordered in the same manner as the product specifications in Part 2, below (i.e. the product specified in Paragraph 2.02.A shall be listed first, etc.). Each Bill of Materials shall include the following information for each item listed:

1) Quantity

2) Description

3) Manufacturer's name and model number

f. Specification Sheets: Manufacturer's specification sheets for each product shall be provided. Each specification sheet shall be uniquely identified in the table of contents and provided with its own bookmark. The specification sheets shall be ordered in the same manner as the product specifications in Part 2, below. Each specification sheet shall be identified by its paragraph number in the specifications and the Manufacturer’s make and model (i.e. 2.02A –Mackie 1604VLZ4). Where specification sheets contain multiple products, the Contractor shall clearly identify the specific product intended for use.

3. Drawing Set: The following material shall be incorporated into a single pdf file.

a. Drawings shall be equal in size to the Contract Drawings and ordered in a manner consist with the Category AV drawings. Drawings shall be clear and legible. The minimum text size for full sized drawings shall be 1/8” high.

b. Cover Sheet: The Cover sheet shall include:

1) Project Name

2) Project Address

3) Drawing Index

c. Schedules: Provide schedules describing drawing symbols used.

d. Location Plan: Provide scaled floor plans of the relevant parts of the work showing the location of system connection panels, conduits, wireways, cable trays, pull boxes, junction boxes, equipment racks equipment and other fixed equipment with appropriate designations.

e. Riser diagrams, showing elevations, room numbers, conduit sizes, service level and wire fill for conduit, connector panel backbox sizes and types, devices, equipment and rack designations.

f. AV System Panel details: Provide a unique scale drawing of each AV wall and rack panel showing the panel label, location and labeling of connectors and cable pass-throughs.

g. Equipment rack elevation, drawings scaled (1-1/2" = 1'-0" or larger), including equipment designation, manufacturer's name, model number, rack location and rack designation.

h. Patch bay elevations, showing patch bay wiring details and labeling designations.

i. Cable schedules and run sheets, associated with each equipment rack and/or any isolated piece of equipment or device, including cable designation, type, manufacturer and manufacturer's type number, wire color, length of run, device and terminal designation and device location, keyed to both the system block diagram and equipment rack elevation drawings. Cable schedules shall also include cable testing results for cables as outlined in Article 3.02.

j. Shop drawings of Contractor fabricated items. Provide detailed drawings showing components, devices and equipment, including dimensions, component values, terminal designations, types, locations, manufacturer's name and model number.

k. Shop Drawings of fixed equipment support and mounting details. These shop drawings shall be stamped and signed by a Structural Engineer licensed in the project state. Include loads, location of attachment to building structure, complete layout of components, devices and equipment, including dimensions, methods of assembly, connections to supporting construction, details of hardware, locations, manufacturer's name and model number. Design calculations, loads, etc. shall be shown on the drawings. Drawings shall be 1/4" = 1'-0" scale minimum. Permissible scales shall be 1/4", 3/4", 1", 1-1/2", and 3" = 1'-0" and full scale.

l. Functional Diagram: Single-line block diagrams showing interconnection of equipment, components, panel connectors, terminal blocks, controls, transformers, loudspeakers and intermediate wiring devices shall be provided. Labels for connectors, terminals, cables and system component shall be included on the drawings. Show detailed system component information including but not limited to manufacturer's name, model number, any specialized part number option and input and output connection information, for each component. No drawing codes shall be permitted. Wiring terminations to connectors, equipment and intermediate wiring devices shall be detailed showing specific wiring conventions and connection methods.

4. Control Panel Layouts: The following material shall be incorporated into a single pdf file.

   a. Table of Contents: A table of contents shall be provided for the pdf file and touch panel layout shall have an entry in the table of contents. Each layout shall have a bookmark associated with it and the bookmark will be accessible via hyperlink in the table of contents to the actual item.

   b. Submit a "storyboard" showing the complete layout of each remote control panel and touch panel screen layout for Owner review prior to programming. The layouts shall be presented in full size with respect to the actual panel or touch screen. The layouts shall be complete, showing the integration of pop-up menus and other partial screen components into the overall layout of the panel. Partial panel layouts will not be acceptable.

5. Samples for approval by the Owner of finishes and materials visible in the completed installation. The Contractor shall provide, at a minimum, samples for the AV connector panels, control panels, trim rings and plates and loudspeaker baffles and grilles.

6. Electronic Files: The Contractor shall submit electronic files of AutoCAD drawing files for the shop drawings and source code files for remote control programming, touch panel layouts and DSP programming. These files shall be delivered in a zip file. Provide separate folders in the zip file for shop drawings, remote control programming and DSP programs. Each file shall be logically and descriptively named.

D. As-Built Drawing Submittal: Prior to the Final Acceptance Observation, the Contractor shall submit the following:

1. Provide one copy of documents required by the Field and Shop Drawings. These documents shall be corrected as noted by the review comments and to reflect the actual installation conditions.
2. Submit a copy of each of the following schedules, lists and data prior to - and as a requirement of - Owner Acceptance of the work of this section:
    a. AutoCAD files of the as-built drawings on CD-ROM.
    b. Control and DSP programming source code. The Owner shall maintain ownership of remote control system and DSP source code at the conclusion of the project and be provided with the source code on CD-ROM as part of the as-built documentation.
    c. Final bills of quantities: complete bills of quantities material as delivered, including a separate schedule of portable equipment.
    d. Equipment schedules: complete, final schedules of equipment and devices provided in each room, by room number and name.
    e. Performance, test and adjustment data: comprehensive documentation of performance verification and correction procedures and measurements, including raw and equalized house curves and equalizer settings.
    f. Maintenance and spare parts schedules: a comprehensive tabulation of equipment, devices, miscellaneous parts and maintenance items, including manufacturer's name, address, model number, systems use and miscellaneous information.
3. The Work will not be accepted until the above documents are reviewed and accepted by the Owner.
4. Aids to Use: submit three copies of each of the following manuals prior to, and as a requirement of, Owner Acceptance of the Work of this section:
    a. Equipment operating instructions; complete, comprehensive instructions for the operations of contractor-fabricated devices and equipment items provided as part of the work of this section.
    b. Manufacturer's installation, operating and service information including schematic diagrams for each item of equipment furnished. This information shall be bound. The manuals shall be ordered in the same manner as the product specifications in Part 2, below. Provide a tab between each manual. Provide a detailed index at the front of each binder indicating specification reference number, manufacturer's trade name, model number and part description.
    c. Printed material for the Contractor-fabricated equipment and systems: operating manuals shall be bond paper copies, offset or laser printed. Drawings, charts and graphs shall be bond paper offset or laser printed. The Contractor-fabricated equipment instruction manuals shall be composed using a single, consistent visual format and writing style; text shall be derived from component equipment manufacturer's instruction manuals and may include reproductions of artwork and other materials. As needed to clearly indicate the operation and maintenance of the Contractor fabricated items.
5. No more than thirty days after Acceptance Testing, submit the As-Built drawings including corrections and comments made during the Acceptance Observation.

6. No more than thirty days after Acceptance Testing, provide one copy of the following:
    a. Certificates; any and licenses, certificates of operation and/or compliance as required.

1.06 QUALITY ASSURANCE

A. Unless otherwise stated, electrical, electronic and optical equipment shall be a product of firms regularly engaged in the manufacture of electrical, electronic or optical equipment. The equipment shall be the latest model or type offered which meets the applicable specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited and shall not be submitted for review.

B. Quality of workmanship and fabrication of equipment and components, which are custom fabricated shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and shall be verified by observation. Only firms having 5 years experience in the fabrication and installation of similar systems shall be allowed to perform the work.

C. Materials and products shall be new and of professional quality. Unless specifically stated in the drawings or specifications, no existing or used materials shall be installed.

D. The Work specified herein, and in each of the allied sections, shall be accomplished by a single Contractor experienced in the design, fabrication, installation, checkout and warranty contract management of systems such as those described in each section. This Contractor shall have complete responsibility for the systems described herein and shall be the single contact point for the Owner with respect to work specified herein.

E. The Contractor shall have on staff a qualified project engineer. The project engineer shall:
    1. Be a university graduate engineer in electrical or electronic engineering or physics, and have at least five years experience with similar electronic and optical specialty systems or other educational experience background as approved by the Owner.
    2. Observe a good working relation with the Owner's Representatives, and cooperate with engineers and technicians assigned by the Owner, who are charged with the operation and maintenance of the system.
    3. Provide technical liaison between the Contractor and the Owner. This shall include participation in meetings and conferences. The project engineer shall be required to be present at the project site for observations, approve the operating and maintenance manuals, and provide the specified instruction to designated members of the Owner's staff.
    4. Be responsible for supervision of technical work that is part of the contract. This supervision includes the following:
        a. Preparation of construction drawings from information within the specifications and the drawings, including approval and signing of shop drawings.
        b. Supervision of shop fabrication and field installation work to assure conformance with the contract drawings, the specifications, and the approved shop drawings to assure workmanship of the highest quality. The project engineer shall oversee the testing of assemblies and sub-assemblies prior to delivery to the project site.
        c. Take a leading role in the specified testing of the completed installation to assure for the Contractor that specifications are met. Work with and assist the Consultant in the observations for approval and acceptance of the system for the Owner.

F. Digital Media System: The Contractor shall have on staff an engineer that has been certified by Crestron Electronics, Inc as a Digital Media Certified Engineer (DMC-E) to assist in the design integration and testing of the Digital Media Transport system.

1. The Contractor shall provide a copy of the engineer's certificate including the certification number and date.
2. The DMC-E shall provide design and integration services for the Digital Media System.
3. The DMC-E shall perform the required testing for the Digital Media System and document the results. These results will be included in the As-Built Documentation for the system.

1.07 WARRANTY AND SERVICE

A. Installation shall be warranted free of faulty workmanship.

B. Components, including solid-state devices, warranted free of defects for a minimum period of one year from date of acceptance. This minimum warranty provision shall not diminish the terms of individual equipment manufacturers' warranties.

C. Paint and exterior finishes, fuses and lamps excluded from above warranties except when damage or failure results from defective materials or workmanship covered by warranty.

D. Provide maintenance service for a period of one year after acceptance of installation. Service shall consist of a minimum of two semiannual visits to the site for checking and adjustment of equipment.

E. Response: Provide four hour telephone warranty service, with 48-hour on-site technical response time. Provide a technician on call from 7 a.m. to 7 p.m. seven days a week.

PART 2 - PRODUCTS

2.01 GENERAL

A. Performance Standards: Equipment shall meet the following minimum performance standards unless specified otherwise:

1. Power Amplifiers:
   a. Input: balanced, bridging, furnish transformer if required for balancing or to eliminate hum.
   b. Output: impedance and power as shown on Drawings, do not ground common, do not combine commons of amplifiers.
   c. THD: less than 0.1%, 30-20,000 Hz, any power.
   d. Dynamic range: at least 110 dB.
   e. Response: +/- 1 dB, 20-20,000 Hz.
2. Audio Amplifiers and Signal Processors:
   a. Input: balanced, bridging, furnish transformer if required to balance or to eliminate hum.
   b. Output: balanced, 600 ohm, transformer. Equipment having provision for plug-in transformers shall have transformers installed; otherwise external transformers shall be installed.
   c. THD: less than 0.05%, 30-20,000 Hz, +18 dBm.

d. Dynamic range: at least 90 dB.

e. Response: +/- 1 dB, 20-20,000 Hz.

3. Microphones:

a. Output: balanced, floating, nominal 150 ohms.

b. Portable wired units with 12' to 18' cord terminated in male XLR-3 connector with pin 2 positive.

c. Wireless microphone receiver with cord as in b., above, except 3' long.

B. Safety Laboratory Listings: Equipment powered from the mains shall be labeled as listed by a testing laboratory acceptable to the local code authority. Underwriters Laboratories, Edison Testing Laboratories, or the City of Los Angeles testing lab will meet this requirement.

2.02 AUDIO AMPLIFIERS AND SIGNAL PROCESSORS

A. DSP Processor (DSP)

1. Features:

a. 12 input, 8 output Digital audio signal processing with user-programmable software.

b. 12 mic/line level analog inputs.

c. 8 mic/line level analog inputs.

d. Frequency Response: 20 Hz to 20 kHz + 0.25/-0.5 dB.

e. Total Harmonic Distortion: <0.0006% at 4 dBu.

f. Cross Talk: < -85dB.

g. 48 KHz sample rate A/D and D/A.

h. Analog to Digital: 24-bit.

i. Digital to Analog: 24-bit.

j. RS-232 control.

k. Ethernet Ports

l. Software shall include feedback suppression modules.

2. Product: Biamp TesiraFORTE AI or equal.

B. DSP Programming:

1. Contractor shall provide the latest version of the DSP operating system.

2. Software: The Contractor shall provide the digital signal processor software for use in the unit. This software shall be based upon the hardware topology shown on the Category AV drawings and shall include operational components necessary to create a fully functional system. A description of the major audio components and control interface are outlined below. It shall be the Contractor's responsibility to include programming to interface between the DSP processor and the remote control system to allow the functions noted in the remote control section of the specifications.

a. Conference Center: The room is provided with audio mixing for microphones and program sources. The following signal chain will be provided:

1) Microphone inputs: Microphone inputs will feed a gain sharing automatic microphone mixer. The output of the automatic mic mixer will feed a feedback suppression module to avoid feedback. The output of the feedback suppression feeds a level control to control the Speech Audio

volume via the remote control system. The output of the level control feeds the Speech Loudspeaker Output and the Hearing Assistance Output, see below.

2) Program Input: Provide a stereo input from the DM SW. The inputs feed input 1 of the Program Router.

3) Overflow Input: Provide a stereo input from the Entry AV system. The inputs feed input 2 of the Program Router.

4) Program Router: The program inputs from the DM SW and Entry feed a two channel stereo router to select the current source. When the remote control system program source is set to Entry Overflow, the router will be set to the Entry program signal. Otherwise, the router is set to the DM SW program signal. The output of the router feeds a stereo level control to control the Program Audio volume via the remote control system. The outputs of the level control feed the Stereo Loudspeaker Output and the Hearing Assistance Output, see below.

5) Speech Loudspeaker Output: The output of the speech level control feeds a 5 band parametric equalizer to optimize the output frequency response of the distributed ceiling loudspeakers and a feedback suppression module to avoid feedback. The output of the equalizer feeds the amplifier input.

6) Stereo Loudspeaker Output: The output of the stereo level controls feed 5 band parametric equalizers to optimize the output frequency response of the stereo loudspeakers. The output of the equalizer feeds the amplifier inputs.

7) Hearing Assistance: The outputs of the speech and stereo level controls feeds a three input mixer to blend the speech and stereo signals to a mono signal. The output of the mixer feeds a 3 band parametric equalizer to optimize the output frequency response of the hearing assistance headsets. The output of the equalizer feeds a digital delay to delay the audio signal to be time aligned with the acoustic output of the loudspeakers for a listener in a seated position in the middle of the room. The output of the delay feeds the RF TRANS.

b. Entry: The room is provided with audio mixing for microphones and program sources. The following signal chain will be provided:

1) Microphone inputs: Microphone inputs will feed a gain sharing automatic microphone mixer. The output of the automatic mic mixer will feed a feedback suppression module to avoid feedback. The output of the feedback suppression feeds a level control to control the Speech Audio volume via the remote control system. The output of the level control feeds the Left, Right and Satellite Mixers, see below.

2) Program Input: Provide a stereo input from the DM SW. The inputs feed input 1 of the Program Router.

3) Internet Radio Input: Provide a stereo input from the Denon 350 UI. The inputs feed input 2 of the Program Router.

4) Manual Mixer Input: Provide a stereo input from the IN Panel. The inputs feed input 3 of the Program Router.

5) Program Router: The program inputs from the DM SW, Denon 350 UI and IN Panel feed a three channel stereo router to select the current source. The output of the router feeds a stereo level control to control the Program Audio volume via the remote control system. The outputs of the level controls feed the Left, Right and Satellite Mixers, see below.

a) When the remote control system program source is set to the IN panel, Blu-Ray or NET INT the router will be set to the DM SW signal.

b) When the remote control system program source is set to Internet Radio, the router will be set to the Denon 350 UI signal.

c) When the remote control system is set to Manual Mixer the router is set to the IN Panel inputs. When set to Manual Mixing, the Speech Audio Level control is muted.

6) Left Mixer: Provide a 2 channel mixer. Input 1 is from the output of the Speech Level Control and Input 2 is from the Left channel of the Program Level Control. The output of the Left Mixer feeds the Left Loudspeaker Output and the Overflow Output.

7) Right Mixer: Provide a 2 channel mixer. Input 1 is from the output of the Speech Level Control and Input 2 is from the Right channel of the Program Level Control. The output of the Right Mixer feeds the Right Loudspeaker Output and the Overflow Output.

8) Satellite Mixer: Provide a 3 channel mixer. Input 1 is from the output of the Speech Level Control and Inputs 2 and 3 are from the Left and Right channels of the Program Level Control. The output of the Satellite Mixer feeds the Satellite Loudspeaker Outputs and the Hearing Assistance Output.

9) Left Loudspeaker Output: The output of the Left Mixer feeds Left Main loudspeaker.

a) The Contractor shall provide signal processing to optimize the output of the loudspeaker. This signal processing may take place in either the DSP or the Amplifier.

b) The Contractor shall review the DSP settings of the applicable existing amplifier channel for any existing signal processing. The Contractor shall verify these settings are correct if they wish to leave the signal processing in the Amplifier or they shall remove the existing signal processing in the amplifier and provide the signal processing in the DSP.

c) The Contractor shall roll off the low end to minimize low frequency build up and muddiness in the Entry.

10) Right Loudspeaker Output: The output of the Right Mixer feeds the Right Main loudspeaker.

a) The Contractor shall provide signal processing to optimize the output of the loudspeaker. This signal processing may take place in either the DSP or the Amplifier.

b) The Contractor shall review the DSP settings of the applicable existing amplifier channel for any existing signal processing. The Contractor shall verify these settings are correct if they wish to leave the signal processing in the Amplifier or they shall remove the existing signal processing in the amplifier and provide the signal processing in the DSP.

c) The Contractor shall roll off the low end to minimize low frequency build up and muddiness in the Entry.

11) Satellite Loudspeaker Outputs: The output of the Satellite Mixer feeds the outputs for the Satellite loudspeakers. Provide two outputs for the two amplifier channels as shown on the drawings.

a) The Contractor shall provide signal processing to optimize the output of the loudspeaker. This signal processing may take place in either the DSP or the Amplifier.

b) The Contractor shall review the DSP settings of the applicable existing amplifier channel for any existing signal processing. The Contractor shall verify these settings are correct if they wish to leave the signal processing in the Amplifier or they shall remove the existing signal processing in the amplifier and provide the signal processing in the DSP. The signal processing shall include, at a minimum, equalization to optimize the frequency response of the loudspeakers and a delay to time align the output with the Main Loudspeakers.

c) The Contractor shall roll off the low end to minimize low frequency build up and muddiness in the Entry.

12) Hearing Assistance: The output of the Satellite Mixer feeds a 3 band parametric equalizer to optimize the output frequency response of the hearing assistance headsets. The output of the equalizer feeds a digital delay to delay the audio signal to be time aligned with the acoustic output of the loudspeakers for a listener in a seated position in the middle of the room. The output of the delay feeds the RF TRANS.

13) Overflow Outputs: Provide the output from the Left and Right Mixers to the left and right Overflow signal outputs.

3. Adjustment: The Contractor shall be responsible for adjustment of control parameters within the digital signal processor program to allow for optimal operation of the system as if the signal processing components within the program were physical audio devices.

C. Passive Mixer (PASS MIX):

1. Features
   a. Resistive Branching Network.
   b. 10 kOhm impedance.
   c. 4 inputs/outputs minimum.
2. Product: RDL STD-10k or equal.

D. Power Amplifier (AMP):

1. Features:
   a. 4 Channel Power Amplifier
   b. Protection features: Clip Limiting, Thermal muting, Short Circuit Protection, Ultrasonic, RF protection, DC Voltage Fault Protection, Turn-On/Turn-Off muting.
   c. Continuously variable speed fans.
   d. Terminal Block balanced input connectors.
   e. Two rack units.
   f. Class D power circuitry.
   g. Power rating: 300 Watts per channel at 8 ohms.
   h. Frequency Response: (at 1 Watt, 20 Hz – 20 kHz): +/- 0.25 dB.
   i. Signal to Noise Ratio: below rated power (20 Hz to 20 kHz): > 108 dB A-weighted.
   j. Total Harmonic Distortion: at full rated power from 20 Hz to 20 kHz: <0.35%.
   k. Damping Factor: 10 Hz to 100 Hz: > 900.

l. Crosstalk (below rated power, 20 Hz to 1 kHz): > 80 dB.

m. Common Mode Rejection (CMR) (20 Hz to 1 kHz, typical): 70 dB.

2. Product: Crown DCi 4|300 or equal.

2.03 AUDIO TRANSDUCERS

A. Wireless Microphone System (WM):

1. Features:

a. Diversity receiver with mic/line level output.

b. Select clear operating frequencies at 25 kHz increments.

c. Operation in UHF band, 470 to 932 MHz; each system on a separate non-interfering frequency.

d. Provide ½ Wave Antennas to match frequency range selected.

e. Provide installation hardware, including connectors, coax cable, mounts, etc. required to install antennas and receivers.

f. Provide rechargeable batteries and chargers for transmitters.

g. Coordinate frequency range of wireless microphone systems based on site specific survey of existing RF activity.

h. Provide one handheld transmitter and one body pack transmitter for each receiver channel.

i. Label each transmitter noting “Conference Center” and number of receiver.

j. 12 hour battery life.

k. RF Carrier Frequency Range: 470 to 932 MHz.

l. Audio Frequency Response: 30 Hz to 20 kHz.

m. Range: 500’ minimum.

2. Product:

a. Receiver (WMREC): Shure ULXD4 or equal.

b. Antenna Coupler: (ANT CPLR): Shure UA221 or equal.

c. Antenna RF Amplifier (RF AMP): Shure UA 830 USPV or equal.

d. RF Antenna: Shure UA8 Series or equal.

e. Body-pack Transmitter (WM LAV): Shure ULXD1 or equal.

f. Lavalier Microphones: Provide a lavalier microphone for each Body-pack transmitter.

1) Lavalier: Shure WL185 or equal.

g. Handheld transmitter (WM HH): Shure ULXD2/58 or equal.

h. Rechargeable Battery: Shure SB900A or equal.

i. Battery Charger: Shure SBC 200 or equal.

3. Quantities:

a. Receiver (WMREC): as shown on drawings.

b. Antenna Coupler (ANT CPLR): as shown on drawings.

c. Antenna RF Amplifier (RF AMP): as required.

d. RF Antenna: Provide antennas for remote mounting as shown on the drawings.

e. Body-pack Transmitter (WM LAV): Provide one per each wireless microphone channel provided.

f. Lavaliere Microphone: Provide one lavalier/head worn microphone for each body pack transmitter.

g. Handheld transmitter (WM HH): Provide one per each wireless microphone channel provided.

h. Rechargeable Battery: Provide 1 battery for each wireless transmitter.

i. Battery Charger: Provide enough chargers to simultaneously charge transmitter batteries.

B. Microphone Carrying Case

1. Features:

a. Provide a carrying case for the microphones.

b. Provide a separate compartment within the foam for each microphone.

2. Product: Refer to Article 2.07 for carrying case specifications.

3. Quantity: 1.

C. CD Player (CD):

1. Features:

a. Professional single well CD player with Bluetooth and USB connectivity.

b. Provide controls for Skip forward and reverse, fast audible forward and reverse.

c. Random play capability

d. Dual 16 bit D/A converters

e. Signal to Noise Ratio: >106dB.

f. Distortion: < 0.007%.

g. Bluetooth pairing of up to 8 devices with Bluetooth 5.0.

h. USB host port.

i. 3.5mm stereo input.

j. RS-232c Control port.

k. Provide the manufacturer's IR remote.

l. Install in Manual Mixer Console Case for the existing Allen+Heath QU16 (See below).

2. Product: Denon DN-500CB or equal.

D. RF Hearing Assistance System (RF TRANS, RF ANT, RF RCVR):

1. Features:

a. Single Channel FM hearing assistance system with fixed transmitter and battery-powered, portable personal receivers.

b. Modulator Carrier Frequencies: 72 MHz or 216 MHz.

c. Transmission range: 1,500 feet minimum.

d. Transmitter output power: 100 mW.

e. Audio Frequency Response: 50 Hz – 15 kHz.

f. Signal to Noise Ratio: 80 dB minimum.

g. Provide separate frequencies for the Conference Center and Entry systems.

h. The Contractor shall perform a site survey to determine the clearest frequency bands (72 or 216 MHz) available at the site and provide models operating in those bands.

i. Signage:

1) A code compliant sign shall be provided at each entry point of a room with a permanent assistive listening system alerting the public to the availability of the system.

2) Provide Owner with code required signage and coordinate the location and installation of the signage with the Owner.

3) Coordinate the color of the sign with the Owner.

j. Transmitter:

1) Provide rack mount kit.

2) Select separate channels within the Modular Carrier Frequency for the Conference Center and Entry.

k. Antenna: Mount antenna in dipole configuration.

l. Receiver:

1) Provide stereo headphones for each receiver.

2) Provide inductive neck loops as required by code.

3) The Contractor shall label the receivers to note which space the receivers will operate in.

m. Battery Charger/Case: Provide carrying cases for receivers, headsets and spare batteries. The cases shall include an integral battery charger.

n. Provide rechargeable battery packs for receivers.

o. Installed Assistive Listening System shall meet the requirements of CBC Section 1104B.2.

2. Product:

a. RF Transmitter (RF TRANS): Listen LT-800 + LT 326 or equal.

b. RF Antenna (RF ANT): Listen LA-122 or equal.

c. RF Receiver (RF RCVR): Listen LR-3200 + LA 402 or equal.

d. Inductive Loop (RF IND): Listen LA-166 or equal.

e. Case/Battery charger: Listen LA-380 or equal.

f. Signage: My Door Sign - Assistive Listening System Sign or equal.

3. Quantity:

a. Conference Center:

1) RF Transmitter (RF TRANS): As shown on drawings.

2) RF Antenna (RF ANT): As shown on drawings.

3) RF Receiver (RF RCVR): 6

4) Inductive Loop (RF IND): 2

5) Case/Battery charger: 1

6) Signage: Provide one sign per entry point.

b. Entry:
1) RF Transmitter (RF TRANS): As shown on drawings.
2) RF Antenna (RF ANT): As shown on drawings.
3) RF Receiver (RF RCVR): 12
4) Inductive Loop (RF IND): 3
5) Case/Battery charger: 1
6) Signage: Provide one sign per entry point.

E. Distributed Loudspeaker (D):
1. Features:
a. 8" full range, coaxial point source driver.
b. 1.0" High Frequency driver.
c. 80 degrees conical dispersion.
d. 60 Watt 70 Volt multi-tap transformer.
e. Sensitivity: 90 dB at 1Watt/1meter, minimum.
f. Frequency Response: 75 Hz to 20 kHz.
g. Max power handling: 140 Watts (16 Ohms).
h. Integral ported Enclosure
i. Provide Manufacturer's Mounting hardware.
j. Color: Black.
2. Product: Tannoy OCV8 or equal.

F. Full Range Loudspeaker (LS):
1. Features:
a. 2-Way full range loudspeaker system.
b. Low Frequency 1-8" cone driver
c. High Frequency System: 1" driver.
d. Dispersion: 100 degrees conical at -6dB.
e. Sensitivity: 91 dB SPL/1Watt at 1meter, minimum.
f. Frequency Response: 62Hz to 16 kHz.
g. Max power handling: 240 Watts at 8 ohms.
h. Integral 60 Watt, multi-tap 70 Volt Transformer. Tap at 8 Ohms.
i. Mounting: Provide manufacturer's ball joint mounting bracket.
j. Color: White.
2. Product: JBL Control C-28-1 or equal.

2.04 VIDEO

A. VGA to HDMI Convertor (HD15 TO HDMI)
1. Features:
a. VGA to HDMI convertor.
b. Input: VGA

c. Output: HDMI
d. Supports Output resolution to 1920 x 1080, progressive.
e. Provide power supply.
f. Provide 10’ HD-15 + stereo audio and 10’ HDMI cable with each Convertor.

2. Product: Monoprice LKV-350 or equal.
3. Quantity: 2

B. TV Tuner (TUNER) [Owner Furnished]:

1. Features:
   a. Digital Cable Tuner
   b. Owner Furnished Equipment.
2. The Contractor shall coordinate installation of the tuner with the Owner and provide wiring and connections to the system per the Category AV drawings.

C. Blu-Ray Disk Player (BLU RAY):

1. Features:
   a. Universal Blue Ray, DVD-Video and Audio CD disc playback.
   b. Video Outputs: HDMI.
   c. Audio Outputs: HDMI, XLR.
   d. HDMI 1.3a compliant with Deep Color support.
   e. RS-232C serial control interface.
   f. Provide manufacturer supplied IR remote.
   g. 1 RU Rack Mount.
2. Product: Denon DN-500BD or equal.

D. Network Presentation Interface (NET INT):

1. Features:
   a. Network interface that allows computers to transmit an image from a computer to the presentation system over the network.
   b. Input: 1 - RJ-45 LAN connectors for connection to network.
   c. Output: HDMI.
   d. Maximum Resolution: 4096 x 2160 at 60 Hz.
   e. RS-232 control port.
   f. HDCP 2.2 compliant.
   g. Compatible with Windows, MacOS, Android and iOS operating systems.
   h. Provide rack mount kit as required.
   i. Lock out front panel controls.
   j. Welcome Screen:
      1) Provide a custom Welcome screen on device with instructions for connecting. Coordinate the instructions with Owner.
      2) Background: Coordinate welcome screen background with Owner.
         a) Do not place any necessary information on the background screen that will be obscured by the Status Bar.

b) Provide instructions to connect to the NET INT for Windows, iOS and Android devices.

c) Provide instructions for Websharing (see below).

3) IP Address Labels: Rename the IP Address Labels as follows:

a) IP Address A: CAAM

4) IP Address: Coordinate IP address for the NET INT with the Owner.

5) Hostname Labels: Rename the hostname labels.

6) Hostnames:

a) Conference Center: Set the hostname to Room 116.

b) Entry: Set the hostname to Room 160.

7) Code: Enable use of the code and set the Code to match the Hostname.

a) Conference Center: Set the Code to 1160.

b) Entry: Set the Code to 1600.

8) Web share: Provide instructions on the Welcome screen for the Web sharing capability of the NET INT.

2. Product: Extron Sharepoint Pro 500 or equal.

E. SDI to HDMI Converter (SDI TO HDMI):

1. Features:

a. HD SDI to HDMI Converter with embedded audio.

b. Input: HD-SDI/SDI, Autosensing.

c. Outputs: HD-SDI loop through and HDMI

d. Formats: 4k, UltraHD, 2K, HD and SD

e. Contractor shall verify that the convertor will accept the maximum native resolution from the provided IMAG Camera System (see below) and output a matching output to the DM SW.

2. Product: AJA Hi5-12G or equal.

F. IMAG Camera System

1. Provide a camera, tripod and rear lens control system to provide an IMAG image for the Entry AV system.

a. Provide wiring between camera and Lens Rear Control Unit.

b. Provide soft cases for the camera and tripod.

c. Training: The Contractor shall include setup and operation of the camera as part of the system training.

2. Video Camera (CAM):

a. Features:

1) High definition handheld color camera.

2) 1/2.84” CMOS type chip, 3.1 Megapixel progressive scan.

3) Lens: 20x Optical Zoom

4) Focal Length: 3.67 – 73 mm

5) Viewfinder: .24 inch LCD

6) Minimum Illumination: 0.1 lux.

7) Shutter Speed: 1/6 s to 1/2000 s.
8) Recording Media: 2 – SDHC/ SDXC slots.
9) Output: 1 – HD-SDI, 1 – HDMI
10) Audio Inputs: 2 – XLR phantom power mic inputs.
11) Provide AC Power Adapter and Soft Carrying Case.
12) Provide 1 – 16 GB memory card.
13) Output Resolutions: 1080/59.94p, 1080/29.97p, 1080/23.98p and 1080/59.94i.

b. Product: Canon XA15 + SC2000 or equal.
c. Quantity: 1

3. Lens Rear Control Kit:
a. Features:
1) Pan bar remote control for CAM.
2) Controls:
a) Record
b) Stop
c) Zoom or Focus controls with selection switch.
d) Focus: Auto or manual.
3) LANC control protocol.
4) Mount to Tripod Pan bar. Provide adapter as needed.
b. Product: Manfrotto MVR901EPLA or equal.
c. Quantity: 1

4. Tripod:
a. Features:
1) Aluminum tripod with fluid head.
2) Maximum Height: 67”
3) Load Capacity: 16 lbs.
4) Leg Sections: 3
5) Head:
a) Maximum weight: 165 lbs.
b) Independent pan and tilt locks.
c) Front tilt: -70/+90 degrees
d) Provide 1 pan bar.
e) Fixed pan and tilt drag.
6) Mount Camera to Tripod.
7) Mount Zoom control on pan bar.
8) Provide soft carrying case for tripod.
b. Product: Manfrotto MVK500190X3 or equal.
c. Quantity: 1

G. Video Projector (VP):

1. Features:
    a. 1 DLP chip video projector.
    b. Native resolution: 1920 x 1200.
    c. Light output: Minimum 6,000 ANSI lumens.
    d. Solid State laser phosphor light source.
    e. Contrast Ratio: 2500:1, minimum.
    f. Horizontal Scan Rates: 15 to 91 kHz.
    g. Vertical Scan Rates: 24 to 120 Hz.
    h. HDMI, DVI-D and HD-15 inputs.
    i. Color: White
2. Product:
    a. Projector: Christie DWU630-GS or equal.
    b. Lens: Christie 1.52 – 2.89 Zoom Lens or equal.
        1) Projection image shall fill the screen image from mounting location. Contractor shall verify focal length in the field prior to installation.

H. Video Projector Mount:
1. Features:
    a. Integral Security Hardware.
    b. Roll: +/- 5% adjustment.
    c. Pitch +/-20% adjustment.
    d. Yaw: 360% adjustment.
    e. Provide the Owner with security keys for projectors. Label keys by room.
    f. Provide additional ancillary hardware as required by the on-site conditions.
2. Product: Chief RPAU Series or equal.

2.05 DIGITAL MEDIA TRANSPORT

A. General:
1. The Contractor's DMC-E engineer shall oversee the integration and installation of the Digital Media System and shall be responsible for coordination of IT related issues with the Owner.
2. Provide static IP addresses as required for each Digital Media device. Coordinate the IP addresses with the Owner prior to installation.
3. Coordinate connection of Digital Media switchers to the building network with the Owner. If the building network makes use of managed switches with Rapid Spanning Tree Protocol (rSTP), disable the rSTP feature of any Digital Media switchers.

B. Digital Media Transmitter (DM TR):
1. Features:
    a. 1 Gang wall mount HDMI to Digital Media signal format transmitter.
    b. HDMI input.
    c. Resolutions supported up to 4k: 30 FPS, 4:2:2 sampling and 36 bit color depth.
    d. Output: 1 Cat5e, Digital Media 8G+ Copper format.

e. EDID format management.
f. CEC control
g. HDCP 2.2
h. Finish: White
i. Power to device provided over DM cable.

2. Product: Crestron DM-TX-4K-100-C-1G-W-T or equal.

C. Digital Media Presentation Switcher (DM SW):

1. Features:
a. Ten input, one output multi-format video and audio switcher with integral microphone mixer and remote control processor.
b. Inputs:
1) 4 – HDMI
2) 4 – multi-format HD15
3) 2 – Single Wire Digital Media Copper format
c. Outputs:
1) 1 – HDMI
2) 1 – Single Wire Digital Media Copper format.
d. Converts analog video and computer signals to HDMI format. Formats supported include VGA, SVGA, XGA, SXGA, UXGA, Component, S-Video and Composite input signals.
e. Stereo audio inputs for HD15 inputs.
f. Microphone Input.
g. Stereo program output.
h. Integral remote control processor.
1) 1 - IR outputs.
2) 2 – Digital I/O ports.
3) 2 – Relay outputs
4) 1 – RS232 outputs.
5) 1 - Remote control buss outputs.
i. EDID format management.
j. HDCP Key management.
k. LAN port.
l. One rack unit.

2. Product: Crestron DMPS3-4K-150-C or equal.

D. Digital Media Receiver with Scaler (DM SCALER):

1. Features:
a. Digital Media to HDMI signal format receiver with integral scaler.
b. Input: 1 RJ45, Digital Media 8G+Copper format.
c. Output: HDMI
d. IR Control: 2 – IR control ports.

e. Relay: 2 relay outputs.
f. RS-232 Port
g. USB HID port.
h. Ethernet Port
i. EDID format management.
j. Set the output resolution of the scaler to match the video resolution of the display.

2. Product: Crestron DM-RMC-4KZ-SCALER-C or equal.

E. Digital Media Distribution Amplifier (DM DA):

1. Features:
a. HDMI to Digital Media distribution amplifier.
b. Input: HDMI
c. Output: 4 RJ45, Digital Media 8G+Copper format and HDMI loop-through.
d. Ethernet Port
e. EDID format management.

2. Product: Crestron DM-DA4-4K-C or equal.

2.06 REMOTE CONTROL

A. General: The remote control system shall be an integrated control system based around a microprocessor driven master control device capable of controlling devices via a wide variety of protocols. The system shall be expandable via peripheral devices including control interfaces, additional control I/O ports and other devices.

B. Control System Features:

1. 32 bit, microprocessor 257 MIPS, min.
2. 32 MB onboard memory with expansion capabilities.
3. Proprietary Control bus for internal wiring of control devices.
4. Integral I/O ports including RS-232, RS-422, RS-485, Serial IR, contact closure.
5. Controller shall include card frame expansion capabilities for additional I/O including 10/100 BASE T Ethernet, USB, and Firewire.
6. Control system shall include outboard components to provide additional control functionality. These outboard devices shall communicate with the master controller via the system's proprietary buss.
7. Contractor shall provide ancillary components and wiring devices necessary to provide a complete, fully functioning system.

C. Touch Panel (TP):

1. Features:
a. 7" wall rack mount touch panel.
b. Control via LAN.
c. Provide black finish.
d. Provide Rack Panel mount.

e. Contractor shall provide GUI developed using Crestron Smart Graphics platform. The GUI of the touch panel shall match the GUI of the Apple iPad Interface (see below).

2. Product: Crestron TSW-770- B-S + TSW 570/1070-RMK-1 (as needed) or equal.

D. Apple iPad Interface:

1. Features:

a. The Contractor shall provide the Owner with the specified App to enable the Owner to control the AV system with an Owner Furnished iPad.

b. The Contractor shall coordinate the downloading of the App to the Owner's iPad and pay for the in App purchase to provide full control of the AV system.

c. The Contractor shall configure that App and in-App purchase so that the Owner retains full control and ownership of the App and the GUI.

d. The Contractor shall provide the GUI for the App so that it matches the look and feel of the rack mounted touch panel. The App GUI shall have the same functionality as the touch panel GUI.

2. Product: Crestron - Go - Touch + In App purchase + Smart Graphics or equal.

E. POE Ethernet Gigabit Switcher (POE SWITCH):

1. Features:

a. 16 Port 10/100/1000 Base T Switcher.

b. 8 ports with POE, 80 Watt total POE power.

c. Unmanaged, plug and play operation.

d. Provide rack shelf for mounting.

2. Product: Linksys LGS116P or equal.

F. General Control System Description:

1. The contractor shall provide programming for the remote control systems as described below.

2. Labels and Text: Avoid abbreviations and acronyms. Device selection and control buttons will be labeled with clear text descriptions. Transport control buttons will use graphical icons. Lettering is 1/8" minimum sans serif font, maintaining a high background to text contrast. Use contrasting color to highlight function or feedback status.

3. Use positive logic. Avoid conditions that may cause command synchronization conflicts. Provide power sensors or other devices to ensure that positive logic conditions are maintained. Wherever possible, use RS-232 or RS-422 devices that provide feedback of equipment status to the control system.

4. Feedback shall be indicated in a logical manner on the touch screens. The status of each controllable device shall be polled to reflect the most accurate state of the overall system condition.

5. Link functions to require the fewest number of user actions to control the audio-visual equipment.

6. Each media selection clears the previous audio and visual selection (i.e. Blu-Ray "ON" clears the audio as well as the visual selection of the previous display material) unless the system is expressly directed to provide breakaway or asynchronous signals.

7. Default conditions shall be established for the system at power-up including device on/off, warm-up routine, power conditions, switcher routing and other default conditions.
8. Buttons (hard and soft) shall incorporate pilot lights or inverted illumination capabilities to designate active states.
9. The programming shall be “foolproof” to the extent that each operation or sequence of operations does not cause the control system to become inoperable to interfere with further procession, correct operations or execution of commands.
10. The compiled program code for the system touch panel shall be resident on the remote control processor to allow loading onto the touch panel directly from the system. Provide adequate system memory for storage of the touch panel code.
11. The un-compiled source program code for the remote control processor shall be resident on the remote control processor. Provide adequate system memory for storage of the source code.

G. Remote Control Submittals and Owner Review:
1. Prior to programming the remote control system, the Contractor shall include as part of the shop drawing submittal and touch panel and Ipad App layouts with control descriptions of the remote control system functions for review. The Contractor shall incorporate comments from the shop drawings review into the programming of the systems.
2. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the Owner shall have a review period of thirty days to observe the operation of the remote control system. At the end of this review period, the Owner may request programming changes relating to the look and feel of the remote control panels or the functionality of commands. The Contractor shall make these changes prior to acceptance of the systems.
3. The Owner shall maintain ownership of the un-compiled source code at the conclusion of the project and be provided with the source code on CD-ROM as part of the as-built documentation.

H. Conference Center Touch Screen Functional Description: The Contractor shall provide programming for the remote control systems as described below and shown on the Category AV drawings.
1. General: This programming description applies to the general function and control of the AV system as expressed through the control interface on the Touch Screen.
2. Programming: The touch screen control interface shall be ordered, mapped, and the buttons defined as described below. The goal of the remote control system programming is to provide a simple, user-friendly interface to the audio-visual system. With this in mind, each button on the remote control panels may initiate control of multiple devices to streamline operation of the system.
3. Title Screen: Contractor shall obtain a bitmap file from the Owner for this screen. This is the default start up screen for power up and sleep modes. Touching the screen in any location will bring user to the Main Screen.
4. Touch Screen: The touch screen shall include a command ribbon across the top of the screen with separate tabs for each control page. The contents of the control pages will be displayed under the command ribbon. The command ribbon will include the following tabs: Room Controls, Video Projection, Room Setup and System Shutdown.
5. Room Controls:

a. Speech Audio: These buttons control the output level of the speech reinforcement system.
    1) Increase Volume: This button is represented graphically as an up arrow. Pressing this button increases the volume of the speech reinforcement system.
    2) Decrease Volume: This button is represented graphically as a down arrow. Pressing this button decreases the volume of the speech reinforcement system.
    3) Mute: Selecting this button will mute the speech signal and display a graphic noting this. Selecting the button again will engage the speech signal and remove the graphic.
    4) Visual Indicator: Provide a vertical bar indicator showing the relative level of the speech reinforcement system.
b. Program Audio: These buttons control the output level of the program audio system.
    1) Increase Volume: This button is represented graphically as an up arrow. Pressing this button increases the volume of the program audio system.
    2) Decrease Volume: This button is represented graphically as a down arrow. Pressing this button decreases the volume of the program audio system.
    3) Mute: Selecting this button will mute the program signal and display a graphic noting this. Selecting the button again will engage the program signal and remove the graphic.
    4) Visual Indicator: Provide a vertical bar indicator showing the relative level of the program audio system.
c. Screen Controls: These buttons provide access to control of the projection screen.
    1) Up: Selecting this button will raise the projection screen to its fully closed position.
    2) Down: Selecting this button will lower the projection screen to fully lowered position. This will be the lower limit switch of the projection screen.
d. Video Projector: These buttons control the output of the video projector:
    1) On: This button turns on the video projector.
    2) Off: This button turns off the video projector.
    3) Mute: Selecting this button disables the output of the video projector at the projector itself. When this command is enabled, it still allows viewing the output of the video switcher on the preview window. Reselecting this button when the projector is disabled will return the display.

6. Video Projection: This screen section contains buttons to select the source equipment for display on the Projection System. These buttons are located at the left hand side of the screen. The transport controls will be located on the right hand side of the screen. When a source is first selected, the system will automatically lower the projection screen and route the source selected to the video projector.
    a. BLU-RAY: Selects BLU-RAY as the source and enables the BLU-RAY Transport Pop-Up Screen.
        1) BLU-RAY Transport pop Up Screen:
            a) Stop Icon: Stops the BLU-RAY player.

b) Play Icon: Starts playing the BLU-RAY player.

c) Pause Icon: Pauses the BLU-RAY player.

d) Chapter Back Icon: Selecting this button moves the BLU-RAY player back to the previous chapter.

e) Chapter Forward Icon: Selecting this button moves the BLU-RAY player forward one chapter.

f) REW Icon: Rewinds the BLU-RAY player. Additional button pushes will increase the pace of the rewind.

g) FFWD Icon: Fast forwards the BLU-RAY player. Additional button pushes will increase the pace of the fast forward.

h) Menu Button: Selecting this button brings up the menu for the BLU-RAY disk in use.

i) Enter Button: This button performs the “enter” or “select” function of the BLU-RAY player.

j) Cursor Controls: These buttons are up, down, left and right cursor control buttons for navigating the BLU-RAY menu system.

k) Close: Selecting this button closes the pop up menu.

b. TV Tuner: Selects Stereo TV Tuner as the source and enables the TV Tuner Pop Up Screen.

1) TV Tuner Transport Pop Up Screen:

a) Channel Up button: Increases channel number 1 position

b) Channel Down button: Decreases channel number 1 position

c) Channel Keypad: Allows selection of channel by entry into numeric keypad.

d) Channel Display: Shows the channel number entered into the system.

e) Enter: This button tunes the TV Tuner to the channel shown in the Channel Display.

f) Close: Selecting this button closes the pop up menu.

c. Entry Overflow: Selects the Overflow from the video signal from the Entry as the video source and selects the overflow audio via the DSP as the program Audio source.

1) Provide a note in the transport control area that states: “No User Controls Available.”

d. AV Panel: Selecting this button displays the HDMI signal from the AV Panel.

1) Provide a note in the transport control area that states: “No User Controls Available.”

e. Wireless Input: Selecting this button displays the output of the NET INT.

1) Provide a graphic in the transport control area that outlines the instructions to connect to the NET INT. Refer to the specification of the NET INT for a description of the connection information.

7. System Setup Screen: The room setup controls allow authorized operators to alter parameters of the room setup. Selecting the Room Setup button on the main menu will enable the Password Access Screen menu centered on the touch panel. Other controls will be unavailable while in the setup menus.

a. Password Access Screen: The room setup controls are password protected so that only authorized technicians can alter the settings. This screen includes a keypad to enter a password, a display to show the entered values and buttons to enter the room set up controls or exit the screen. Coordinate the password with the Owner.
    1) Keypad: A standard number keypad to allow entry of a password into the system for access.
    2) Display: The display will show the keystrokes entered on the keypad.
    3) Enter: Selecting this button will test the password displayed against allowable passwords. If the password is incorrect, the display will be blanked and the user may enter another password. If the password is correct, the Setup Selection Screen is enabled.
    4) Exit: Selecting this button returns the user to the Main screen.
b. Room Setup Screen: This screen allows the operator to select the system parameters to adjust.
    1) Video Projector: Selecting this button displays the Video Projector Setup Screen.
    2) Presentation Switcher (DM SW): Selecting this button displays the Presentation Switcher Setup Screen.
    3) Audio DSP: Selecting this button displays the Audio DSP Setup Screen.
    4) Close: Selecting this button returns the user to the Room Control screen.
c. Video Projector Setup Screen: This screen contains controls for the video projector setup.
    1) Provide Navigation buttons and an Enter button to control the projector's on screen menus via RS-232 or IR remote control.
    2) Provide a button to return to the Room Setup Screen.
d. Presentation Switcher Setup Screen:
    1) Provide separate buttons for each video and audio input and output to allow independently selecting the video and audio sources for each output. This will allow set up of breakaway audio.
    2) Provide a button to return to the Room Setup Screen.
e. Audio DSP Setup Screen: This screen contains volume controls for each microphone input on the DSP to allow the user to adjust volume levels of individual microphones.
    1) Provide level up/down controls and a visual indicator for each microphone input.
    2) Provide a "Reset" button to return microphone levels to the default condition for microphones determined by the Contractor based upon the typical microphone selections.
    3) Provide a button to return to the Room Setup Screen.

8. System Shutdown: Selecting this tab will display the System Shutdown Pop Up Menu.
    a. System Shutdown Pop Up Menu: This menu will display the question: "Are you sure you want to turn off the AV System?" and include the following buttons:
        1) Yes: Selecting this button will shut the AV system down via the AC Sequencing system and individual component controls. The projection

screen will be raised, the video projector will turn off and the AC sequencer will power down the AV system.

2) No: Selecting this button will close the Pop Up Menu.

I. Entry Touch Screen Functional Description: The Contractor shall provide programming for the remote control systems as described below and shown on the Category AV drawings.

1. General: This programming description applies to the general function and control of the AV system as expressed through the control interface on the Touch Screen.
2. Programming: The touch screen control interface shall be ordered, mapped, and the buttons defined as described below. The goal of the remote control system programming is to provide a simple, user-friendly interface to the audio-visual system. With this in mind, each button on the remote control panels may initiate control of multiple devices to streamline operation of the system.
3. Title Screen: Contractor shall obtain a bitmap file from the Owner for this screen. This is the default start up screen for power up and sleep modes. Touching the screen in any location will bring user to the Main Screen.
4. Touch Screen: The touch screen shall include a command ribbon across the top of the screen with separate tabs for each control page. The contents of the control pages will be displayed under the command ribbon. The command ribbon will include the following tabs: Room Controls, Video Projection, Room Setup and System Shutdown.
5. Room Controls:
    a. Speech Audio: These buttons control the output level of the speech reinforcement system.
        1) Increase Volume: This button is represented graphically as an up arrow. Pressing this button increases the volume of the speech reinforcement system.
        2) Decrease Volume: This button is represented graphically as a down arrow. Pressing this button decreases the volume of the speech reinforcement system.
        3) Mute: Selecting this button will mute the speech signal and display a graphic noting this. Selecting the button again will engage the speech signal and remove the graphic.
        4) Visual Indicator: Provide a vertical bar indicator showing the relative level of the speech reinforcement system.
    b. Program Audio: These buttons control the output level of the program audio system.
        1) Increase Volume: This button is represented graphically as an up arrow. Pressing this button increases the volume of the program audio system.
        2) Decrease Volume: This button is represented graphically as a down arrow. Pressing this button decreases the volume of the program audio system.
        3) Mute: Selecting this button will mute the program signal and display a graphic noting this. Selecting the button again will engage the program signal and remove the graphic.
        4) Visual Indicator: Provide a vertical bar indicator showing the relative level of the program audio system.
    c. Audio Control: These buttons control the audio mode of the AV system.
        1) Automatic Mixer: Selecting this button selects the automatic microphone mixer and program router in the DSP as the audio sources via the Audio Control Router.

2) Manual Mixer: Selecting this button selects the Manual Mixer inputs as the audio source via the Audio Control Router.

d. Video Projector: These buttons control the output of the video projector:

1) On: This button turns on the video projector.

2) Off: This button turns off the video projector.

3) Mute: Selecting this button disables the output of the video projector at the projector itself. When this command is enabled, it still allows viewing the output of the video switcher on the preview window. Reselecting this button when the projector is disabled will return the display.

6. Video Projection: This screen section contains buttons to select the source equipment for display on the Projection System. These buttons are located at the left hand side of the screen. The transport controls will be located on the right hand side of the screen. When a source is first selected, the system will automatically lower the projection screen and route the source selected to the video projector.

a. BLU-RAY: Selects BLU-RAY as the source and displays the BLU-RAY Transport Pop-Up Menu.

1) BLU-RAY Transport Pop Up Screen:

a) Stop Icon: Stops the BLU-RAY player.

b) Play Icon: Starts playing the BLU-RAY player.

c) Pause Icon: Pauses the BLU-RAY player.

d) Chapter Back Icon: Selecting this button moves the BLU-RAY player back to the previous chapter.

e) Chapter Forward Icon: Selecting this button moves the BLU-RAY player forward one chapter.

f) REW Icon: Rewinds the BLU-RAY player. Additional button pushes will increase the pace of the rewind.

g) FFWD Icon: Fast forwards the BLU-RAY player. Additional button pushes will increase the pace of the fast forward.

h) Menu Button: Selecting this button brings up the menu for the BLU-RAY disk in use.

i) Enter Button: This button performs the “enter” or “select” function of the BLU-RAY player.

j) Cursor Controls: These buttons are up, down, left and right cursor control buttons for navigating the BLU-RAY menu system.

k) Close: Selecting this button closes the pop up menu.

b. Internet Radio: Selects the Denon 350 UI as the program source via the DSP and Mutes the output of the video projector and displays the Internet Radio Pop Up Menu.

1) Internet Radio Pop Up Menu:

a) Stop Icon: Stops the Internet Radio.

b) Play Icon: Starts playing the Internet Radio.

c) Pause Icon: Pauses the Internet Radio.

d) REW Icon: One press reverses the Internet Radio one track position. Holding the button rewinds the current track.

e) FFWD Icon: Advances the Internet Radio one track position. Holding the button fast forwards the current track.

f) Repeat: Repeats the current selection.

g) Close: Selecting this button closes the pop up menu.

c. IN Panel: Selecting this button displays the HDMI signal from the IN Panel.

d. Wireless Input: Selecting this button displays the output of the NET INT.

1) Provide a graphic in the transport control area that outlines the instructions to connect to the NET INT. Refer to the specification of the NET INT for a description of the connection information.

e. Camera: Selects the SDI Camera input as the program source.

1) The Camera input of the DM SW shall be configured so that the audio is always muted.

7. System Setup Screen: The room setup controls allow authorized operators to alter parameters of the room setup. Selecting the Room Setup button on the main menu will enable the Password Access Screen menu centered on the touch panel. Other controls will be unavailable while in the setup menus.

a. Password Access Screen: The room setup controls are password protected so that only authorized technicians can alter the settings. This screen includes a keypad to enter a password, a display to show the entered values and buttons to enter the room set up controls or exit the screen. Coordinate the password with the Owner.

1) Keypad: A standard number keypad to allow entry of a password into the system for access.

2) Display: The display will show the keystrokes entered on the keypad.

3) Enter: Selecting this button will test the password displayed against allowable passwords. If the password is incorrect, the display will be blanked and the user may enter another password. If the password is correct, the Setup Selection Screen is enabled.

4) Exit: Selecting this button returns the user to the Main screen.

b. Room Setup Screen: This screen allows the operator to select the system parameters to adjust.

1) Video Projector: Selecting this button displays the Video Projector Setup Screen.

2) Presentation Switcher (DM SW): Selecting this button displays the Presentation Switcher Setup Screen.

3) Audio DSP: Selecting this button displays the Audio DSP Setup Screen.

4) Close: Selecting this button returns the user to the Room Control screen.

c. Video Projector Setup Screen: This screen contains controls for the video projector setup.

1) Provide Navigation buttons and an Enter button to control the projector's on screen menus via RS-232 or IR remote control.

2) Provide a button to return to the Room Setup Screen.

d. Presentation Switcher Setup Screen:

1) Provide separate buttons for each video and audio input and output to allow independently selecting the video and audio sources for each output. This will allow set up of breakaway audio.

2) Provide a button to return to the Room Setup Screen.

e. Audio DSP Setup Screen: This screen contains volume controls for each microphone input on the DSP to allow the user to adjust volume levels of individual microphones.

1) Provide level up/down controls and a visual indicator for each microphone input.

2) Provide a “Reset” button to return microphone levels to the default condition for microphones determined by the Contractor based upon the typical microphone selections.

3) Provide a button to return to the Room Setup Screen.

8. System Shutdown: Selecting this tab will display the System Shutdown Pop Up Menu.

a. System Shutdown Pop Up Menu: This menu will display the question: “Are you sure you want to turn off the AV System?” and include the following buttons:

1) Yes: Selecting this button will shut the AV system down via the AC Sequencing system and individual component controls. The projection screen will be raised, the video projector will turn off and the AC sequencer will power down the AV system.

2) No: Selecting this button will close the Pop Up Menu.

J. Defaults: The system will make the following adjustments upon system power up or rest.

1. Refer to the Category AV drawings for information on the default signal routing of the AV system.
2. Program audio: The program audio signal shall follow the video source of the video switcher.
3. Audio volume: Default audio volume is the midpoint setting of the volume controls.

K. Network Control: The Contractor shall provide a web browser based control interface for each touch panel included in the AV systems so that it may be accessed via the building network. The browser page shall be password protected to allow only authorized users access.

L. Mobile Device Control: The Contractor shall provide the Crestron – Go – Tablet app and necessary in App purchases to replicate controls for both the Entry and Conference Center touch panels.

1. The APP GUI’s shall be programmed using the Crestron Smart Graphics package and the look and feel of the App GUI’s shall match that of the touch panels.
2. The Contractor shall coordinate the installation of the Apps on Owner Furnished iPads, payment of the in-App purchase fees and programming of the GUI’s with the Owner. The Apps for each room may be installed on separate iPads, one for each room, or a single iPad.
3. The Owner shall maintain ownership of the un-compiled source code for the GUI’s at the conclusion of the project and be provided with the source code on CD-ROM as part of the as-built documentation.

M. Fire/Life Safety Loudspeaker Cutoff: Control signals from the fire and life safety will be connected to the remote control processor or digital signal processor. In the event of a fire or life safety alarm, the remote control system will mute the sound system.

2.07 RACKS, WIRE, CONNECTORS AND MISC. HARDWARE

A. Wall Mounted Equipment Rack:
   1. Features:
      a. Wall mounted hinged equipment cabinet.
      b. Cable management track.
      c. 3/4" rack space elevation.
      d. Accepts EIA standard 19 panel" width, 22" overall depth.
      e. 1/2", 3/4", 1", 1-1/2", electrical knockouts top and bottom rear.
      f. 12 Ga. construction.
      g. Ventilated side panels.
      h. Secure rack to wall using manufacture's recommended method.
      i. Provide vented locking front door.
      j. Size rack per the rack elevations on the Category AV drawings.
      k. Racks shall be attached to building structure per the manufacturer's recommended method.
   2. Product: Middle Atlantic DWR Series with LVFD Series door or equal.

B. Manual Mixer Console Case:
   1. Features:
      a. Provide a mixer road case for the existing Allen+Heath GU16 Mixing Console with 4 RU rack under the mixer.
      b. Constructed of 3/8" plywood, interior braced and faced with plastic laminate.
      c. Doghouse top with locking front and rear panels.
      d. 1" foam padding on interior compartment.
      e. Mixer shall be mounted to top facing equipment rack rails using manufacturer's hardware. Provide 4 RU vertical rack space below mixer for CD and other equipment.
      f. Color: Black.
   2. Acceptable: Custom by Grundorf or equal.
   3. Quantity: 1

C. Carrying Case:
   1. Features:
      a. Watertight plastic equipment cases.
      b. Polypropylene Structural Resin case material.
      c. Neoprene Sponge O-rings to seal lid.
      d. Provide 1.7 lb/cubic foot foam inserts with custom sized cavities for each piece of equipment as required.
      e. Size to accommodate required equipment into a single case.
   2. Product: Pelican, Masco or equal.
   3. Quantity: Provide carrying cases as noted.

D. Blank Panels:
   1. Features:
      a. 1/8" anodized brushed aluminum finish.
      b. 19" standard EIA width.
   2. Product: Middle Atlantic PHBL Series or equal.

E. Vent Panels:
   1. Features:
      a. 16 Ga. perforated steel with black power coat finish.
      b. 60% minimum open area.
      c. 19" standard EIA width.
   2. Product: Middle Atlantic VT Series or equal.

F. Rack Kit(s):
   1. Features:
      a. 1/8" anodized brushed aluminum finish.
      b. Custom manufactured for each piece of equipment.
      c. 19" standard EIA width.
      d. Provide 1 for each non-standard 19" EIA piece of equipment.
   2. Product: Middle Atlantic or equal.

G. Rack Drawer (DRAWER):
   1. Features:
      a. Rack-mountable drawer with lock.
      b. RU height as shown on drawings.
      c. 14” Deep.
   2. Product: Middle Atlantic D Series with LK option or equal.

H. Security Rack Screws:
   1. Use for mounting rack mounted equipment.
   2. Provide Owner with 6 mounting bits for provided screws.
   3. Product: Middle Atlantic Star Post HTX or equal.

I. Power Sequencer (AC SEQ):
   1. Features:
      a. Programmable sequencing of AC receptacles in rack mount enclosure.
      b. Remote power on switch to control position.
      c. Controls a minimum of eight 15 amp duplex output circuits.
      d. Use additional standard outlet strips to provide additional outlets as required.
   2. Sequence:
      a. Power On Sequence: Power audio sources and "head end" equipment on first. Then energize power amplifiers delaying 5 second between each amplifier. The DM SW shall remain on at all times.

b. Power Off Sequence: Reverse the above description waiting until the amplifier capacitors completely discharge to eliminate any transit pops due to source equipment power off.

3. Product: Furman CN-1800S or equal.

J. Rear Rack Work Light:

1. Features:
   a. Movable work light with magnetic base.
   b. 60 Watt rough service bulb.
   c. On/Off switch.
   d. Adjustable arm.
2. Product: Middle Atlantic WL-60 or equal.
3. Quantity: Provide 1 per equipment rack provided.

K. Audio Terminal Blocks:

1. Audio lines leaving an equipment rack shall be connected via barrier-type screw terminal blocks.
2. Acceptable: Kukla or equal.

L. Installed Wiring:

1. Pre-manufactured cables with molded consumer grade connectors are not acceptable and shall not be used.
2. Loudspeaker lines in conduit: standard electrical wire, stranded copper, color coded, THHN type.
   a. Low Z: AWG #12.
      1) Product: West Penn 227, Belden 5000UP, or equal.
   b. 70 Volt: AWG #16
      1) Product: West Penn C225, Belden 8471, or equal.
   c. 70 Volt Plenum Rated, AWG #16
      1) Product: West Penn 25294B or equal.
3. Mic and Line, shielded pair #22,
   a. Product: Belden 8761, West Penn 291 or equal.
4. SDI Video 75 ohm Coax:
   a. Product: Belden 1694A or equal.
5. Control System Buss:
   a. Crestron CRESNET-NP or equal.
6. DC Control Lines:
   a. Low current loads (mute, VCA, LED): AWG #20.
   b. Medium current loads (relays, switch lamps): AWG #18.
7. Wireless Microphone Antenna: Provide cables recommended by Wireless Microphone equipment manufacturer for given length of cable run based upon field conditions.
8. Hearing Assistance Antenna: Provide cables recommended by Hearing Assistance equipment manufacturer for given length of cable run based upon field conditions.

9. RS-232 Control Lines:
    a. Product: Belden 8102, West Penn 271, or equal.
10. Category 6:
    a. Product: Belden 1872A, West Penn M57622 or equal.
11. Digital Media:
    a. Product: Crestron DM-CBL-ULTRA-NP or equal.
12. Wire labels: Permanent cables shall be marked with wire labels at both ends of the cable. The wire labels shall utilize plastic shrink-wrap, protecting the text and ensuring they remain affixed to the wiring.

M. Connectors:
1. Loudspeaker:
    a. Panel: Neutrik NL4MP or equal.
    b. Cords: NL4FC or equal.
    c. Cable couplers: Neutrik NL4MM or equal.
    d. Wooden box mounting: Neutrik NL4MPR or equal.
2. Mic and Line XLR-type:
    a. 3-pin female XLR-type cable end.
        1) Product: Neutrik NC3FX or equal.
    b. 3-pin male XLR-type cable end:
        1) Product: Neutrik NC3MX or equal.
    c. 3-pin female XLR-type panel.
        1) Product: Neutrik NC3FDL or equal.
    d. 3-pin male XLR-type panel:
        1) Product: Neutrik NC3MDL or equal.
    e. 4-pin male XLR-type cable end:
        1) Product: Neutrik NC4MX or equal.
    f. 4-pin female XLR-type panel.
        1) Product: Neutrik NC4FDL or equal.
3. Mic and Line Phone-type:
    a. ¼”male cable end.
        1) Product: Switchcraft 35HDNN, Neutrik NP3C or equal.
    b. ¼” female panel.
        1) Product: Switchcraft 35RAPC2BH3, Neutrik NJ3FP6C or equal.
4. SDI Video: 75 ohm Coax
    a. Provide correct connector for each coaxial cable type.
    b. Cable End: Neutrik NBNC75BTU11 or equal.
    c. Chassis: Neutrik NBB75DFI or equal.
5. Digital Media:
    a. CAT7a: Crestron DM-CONN or equal.
    b. Cable Connector Carrier: Neutrik NE8MC-1 or equal.

c. Panel Connectors: Neutrik NE8FDP or equal.

6. Control and Data:
   a. RJ –45: TIA/568-A or B.
   b. DB-9/ RS-232C:
   c. Products: Markertek 9M, Pacific Custom Cable D9MS, or equal.
7. DC power: Provide locking connector

N. Portable Cables:
1. Refer to the Category AV drawings and other portions of the specifications for additional requirements. Unless otherwise noted, microphone and line level portable cables shall be by Whirlwind or equal.
2. Microphone Extension Cables: Ready-made with XLR connectors with rubber jackets by Whirlwind or equal.
   a. Quantity:
      1) 4 - 25' cables.
      2) 2 - 50' cables.
3. Video extension cables: HD-SDI with BNC connectors:
   a. Quantity:
      1) 1 - 25’ cable.
      2) 1 - 50’ cable.
      3) 1 - 100’ cable.
4. HDMI Cables: distance rated HDMI cables with locking connectors.
   a. 15’ cable
   b. 25’ cable
   c. Cable retention: 25 lbs, minimum.
   d. Provide 1 set of HDMI cables for each HDMI input.
   e. Product: Perfect Path 700 Series or equal.
5. Cat6 Extension Cables:
   a. Quantity:
      1) 2 - 15’ cables
      2) 2 - 25’cables
      3) 1-100’ cable
6. Reusable Portable Cable Tie
   a. Products: Rip Tie, Cord Lox or equal.
   b. Quantity: 1 per portable cable provided.

O. Receptacle Panels, aluminum:
1. Material: 1/8” thick aluminum.
2. Sizes:
   a. Verify panel sizes required each backbox in the field.
   b. Surface Mount: Panels for surface mounted backboxes shall be equal in dimension to the backbox so that the panel edges are flush with the sides of the backbox.

c. Flush Mount: Panels for backboxes mounted flush to a finished wall or ceiling shall have dimensions at least ½" greater than the backbox dimensions so that the panel covers the gap between the backbox and the finished surface.

3. Finish: Panels shall be brushed aluminum.
4. Engraving: Panels shall be engraved with text a minimum of 1/8" in height and back-filled in a contrasting color to the finish surface of the panel.
   a. Brushed aluminum panels shall have black backfill.
5. Submit engraved sample for approval by Owner.
6. Product: Custom by Contractor.

P. Wire Clamp:
1. Features:
   a. Material: nylon, UV stabilized.
   b. Color: black
   c. Size: holding diameter sized as required based on conductor size.
2. Product: Richco N Series, or equal.

Q. Wire Harness Cover:
1. Exposed wiring (i.e. wiring from AV plates to fixed equipment) shall be bundled together and covered with a flexible expandable mesh covering to protect the cables. Wire harness covering shall be sized as required to accommodate each cable bundle.
2. The ends of the mesh covering shall be dressed at each end of the cable length using shrink wrap plastic tubing.
3. The cable harness cover shall be black. Provide a sample to the Owner for review and approval prior to installation.
4. Product: Techflex Flexo PET or equal.

R. Anti-Theft Hardware:
1. Features:
   a. For fixed AV system components located in classrooms or public spaces (except distributed ceiling loudspeakers) mounted 12'0" or less above the finished floor the Contractor shall provide anti-theft hardware to prevent the theft of the equipment.
   b. Secure anti theft hardware to AV component and mounting bracket or building structure.
   c. Provide glue down security plate, lock and steel cable.
   d. Provide the Owner with three sets of keys per lock. Label keys by Room Number and Equipment description.
2. Product: Security Kit, Tufnut or equal.

S. DC Power Supplies:
1. 12, 24 volt, capacity as required with 100% extra, UL (or other) listed (PS): Condor linear or approved equal, submit cut sheets.
2. Products: Condor, Equipment Manufacturer's power supply or equal.

T. Loudspeaker Rigging:

1. Category AV drawings are for information only. The Contractor shall supply Shop Drawings of mounting details stamped by a California registered structural engineer prior to installation.

U. Microphone Stands:

1. General Purpose Microphone Stand:
    a. Features:
        1) 12” dia. base.
        2) 37” to 66” vertical extension.
        3) Black matte finish.
    b. Product: Atlas MS-20E or equal.
    c. Quantity: 2
2. Desk Microphone Stand:
    a. Features:
        1) 6” dia. base.
        2) 8” to 13” vertical extension.
        3) Black matte finish.
    b. Product: Atlas DS-7E or equal.
    c. Quantity: 2

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. The following installation requirements shall govern the design, fabrication and installation of the system(s) specified herein. In case of a discrepancy between these overall system standards and the individual equipment item specifications, the latter shall govern:
    a. The equipment specified shall be installed according to standards of good human engineering practice and the conditions specified herein.
    b. Workmanship on the installed systems shall be of professional quality, best commercial practice and accomplished by persons experienced in the techniques and standards of the particular industries involved.
    c. The specifications describe required performance. The specifications with the contract drawings indicate a general design; the Contractor shall supply from his background of experience and knowledge the necessary supporting details to provide a fully functioning system.
    d. In general, the drawings show dimensions, positions, and kind of construction. The specifications describe materials, qualities and methods. Any work called for on the drawings and not mentioned in the specifications, or vice versa, shall be performed as though fully set forth in both. In case of differences between the drawings and the specifications, the decision of the Owner shall govern. Work not particularly detailed, marked or specified shall be construed to be the same as similar parts or areas that are detailed, marked, or specified.

2. Equipment markings shall present only needed information and shall be readable from the operator's normal work position. These markings shall be designed to minimize ambiguous interpretation.
3. Control panels shall be designed to reduce chances of human error and controls shall be natural and consistent with normal operator expectations.
4. Control consoles and their panel mountings shall be provided with the necessary controls, indicators and switches, etc., as outlined in the pertinent sections of this specification. The grouping of the controls shall be in accordance with the drawings and shall be arranged to present an orderly, functional appearance. The layout of controls shall be such that priority of accessibility shall be given to those facilities that frequently require attention.
5. The design of the system shall simplify the operator's task and insure maximum performance and reliability while minimizing possibilities for human error and providing a comfortable environment for the operator during operation.
6. At the operational level (i.e., patch panels, Audio-Visual connector panels, etc.) connectors shall be clearly labeled by function and number. When there are multiples of the same function (For example, a given microphone line may appear at several locations.), the same label shall be shown at each location.

B. The Conduit System:
1. The Category AV drawings indicate the number, type and location of the receptacle, wire and cable requirements and Equipment Room layouts, which are the responsibility of the Contractor. The conduit diagrams indicate schematically the functions served by the conduit system. Also, the conduit diagrams may indicate the locations at which functions are served at several locations in the facility. See the general installation notes for additional information and requirements as shown on the Category AV drawings.
2. The Contractor shall inspect the conduit and report any discrepancies to the Owner in writing.
3. The Contractor shall verify continuity of conduits as described on the Category AV drawings.
4. The Contractor shall be responsible for supplying any additional conduit that may be required to complete the system installation in accordance with the drawings.
5. It shall be the responsibility of the Contractor to obtain the exact location of any pull boxes, "LBs" or other intermediate junction boxes.
6. The Contractor shall also verify that conduits are adequate for the wiring and functions specified. If the Contractor substitutes cables from the specified wiring the Contractor shall bear the sole responsibility for reengineering the conduit as required.
7. Each conduit shall contain wires or cable of the same signal level or the same type of circuitry only. Each separate service level designation shown on the AV conduit riser shall be run in their respective, separate conduits and conduit landings in backboxes or equipment racks shall be grouped by service level.
8. Ground power conduits to the power system ground. Do not connect power system conduits to the racks or to the audio-visual system ground.

C. Equipment Arrangement:
1. The general layout is indicated in the drawings. The Contractor shall prepare and submit a detailed layout of fixed equipment for approval by the Owner.

2. The Contractor shall maintain accessibility to the rear of the equipment racks. See specification section 3.01.D.5 for minimum clearance information.

D. Equipment Rack Assemblies:

1. General:

a. Equipment rack(s) shall be completely assembled, tested and programmed in the Contractor's shop. No rack assembly shall be performed at the project site. After the equipment racks are tested the Contractor shall notify the Owner in writing that the equipment rack assemblies are ready for observation by the Owner. The Contractor shall allow adequate time in the project schedule for any modifications noted during the observation necessary to satisfy the contract drawings and specifications prior to delivery of the racks to the jobsite.

b. Use rear and mid rails for intermediate terminations. Maintain accessibility to the rear of the equipment.

c. Mid rails must be used to support equipment weighing more than 50 pounds.

2. Wiring Harnesses:

a. Equipment rack wiring shall be "Harness" style. "Point to Point" rack wiring is not acceptable. The individual wiring harnesses shall be located at the sides of the equipment rack and individual cables shall be broken out to the rear of components where the connectors are located. Patch bay cabling shall be harnessed in such a way as to allow any cable to be reconnected to any patch location within a single patch bay.

b. Wiring service levels shall not be mixed in an individual harness; there shall be a separate wiring harness for each service level.

c. Low level signal harnesses shall be separated from the AC power lines and high level signal harnesses by a minimum of 12 inches.

d. When 3 or more equipment racks are used, interconnection between equipment racks shall be performed with multi channel cable and multi-pin connector assemblies. It is the intent that each rack shall be a complete, stand-alone assembly allowing the system to be completely tested in the Contractor's shop.

3. Equipment Labels:

a. Rack-mounted equipment shall be labeled on front and back, as to function using engraved black/white laminated plastic blocks. For example: “LEFT HI-FREQ AMPLIFIER” or “CENTER EQUALIZER”

b. Use permanent professional quality labels such as "Gravelply" or approved equal. Stick-on strip labels such as those from Dyno or Brother are not acceptable.

4. Internal A/C Receptacles:

a. Maintain grounding as shown on the Category AV drawings and described herein.

b. Locate internal AC receptacles on the left side of the rack and harnesses on the right side of the rack. In the event that there are 2 equipment racks side by side locate the A/C receptacles in the middle of the equipment racks and the wiring harnesses to the outer sides.

c. Provide 1 work lamp at the top rear of each equipment rack.

5. Installation:

a. The equipment rack(s) shall be installed in the Equipment Room(s) in the configuration shown on the Category AV drawings. The location of the racks shall allow for an absolute minimum of 36 inches, preferably 42 inches, of clear space

measured from the front of the rack(s) and from the rear of the equipment rack(s) to any installed equipment or walls.

b. Stationary equipment rack(s) shall be secured to the building structure to meet seismic and code requirements.

c. Interconnecting multi-channel cabling shall be led laterally from equipment rack to the vertical rack member, opposite from the AC power and then run vertically, remaining as exposed and accessible as possible. Wherever corners in multi-channel cabling occur strain relief spiral covering shall be used. Cable clamps shall be non-conducting or have soft insulating covers.

d. Audio field lines entering the Equipment Racks shall be connected to the rack wiring via an intermediate terminal block. Video field lines may be connected directly to the equipment or patch bays. In the event that a patch bay with an E3 or E90 connector is used, the patch bay may serve as the terminal block. This configuration will also facilitate the testing of the systems in the Contractor's shop.

e. Connections of lines at terminal blocks, as well as at signal receptacles, shall be mechanically secured and then soldered. No unsoldered connections shall be permitted. Where lines approach the racks and terminal blocks they shall also be mechanically anchored at the rack, and provided with sufficient slack length to avoid strain, abrasion or wear.

E. Wiring and Cabling:

1. General:

a. Physically segregate and separate high level signal lines from low level signal lines by a minimum of 6” within the equipment racks.

b. Control cables and power distribution wiring shall not be installed adjacent to signal cables. Power distribution cabling shall be on the opposite side from signal wiring in equipment enclosures and shall be uniformly located throughout an installation.

c. A wall location near the racks shall be chosen and suitable suspension "fingers" provided so that patch cords of a given type can be grouped and suspended.

d. Wire and cable utilized in systems interconnection shall be of the flame-retardant type (FR-1 flame test).

e. Cabling or system interconnection which passes through or into acoustically isolated areas, such as sound locks and studios, shall be suitably sealed after cable has been installed.

2. Wire Labels:

a. During installation both ends of wires or cables shall be clearly labeled with permanent, machine lettered wire labels. The Contractor shall submit a sample to the Owner for review and approval.

b. The wire labels shall be numbered consecutively with a leading service level designation.

c. The wire labels shall not be more than 6 inches or less than 2 inches from the connector or termination at each end of the cable.

d. Wire labels shall be covered with clear plastic shrink-wrap, protecting the text and ensuring the labels remain affixed to the wiring.

3. Documentation:

a. Maintain a log including label, route and termination information for each cable.

b. A detailed wiring diagram shall be furnished with wire numbers shown as part of the as-built documentation. Spare cable shall be shown on the As-Built documentation.

4. Cable Management:
   a. Cabling and wiring within the Equipment Room(s) that are semi-permanent (i.e., those leading from rack to rack, rack to conduit terminus or rack to equipment locations) shall be carried not within conduit, but rather within ducts, troughs or cable trays mounted along walls or below the ceiling.
   b. Appropriate hooks along the wall or on the ceiling will aid in running occasional or frequently changed extension cables to use position.
   c. Cables shall be grouped and bundled by type and routed from source to termination in a uniform manner throughout equipment housings. Care shall be taken not to break the insulation or deform the cable by harness supports. Cables shall not change relative position in a cable group throughout a cable route.
   d. Cable support bars shall be installed to support cables in areas of dense harness breakouts such as behind patch panels, distribution amplifiers and other multiple input/output devices.
   e. Edge protection material ("cat track") or grommets shall be installed on the edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edges.
5. Terminations:
   a. The Contractor shall employ the latest termination practices and materials.
   b. Signal and control cable ends shall be neatly formed, and shrinkable tubing shall be applied where necessary to secure the insulation against fraying or raveling.
   c. Internal rack terminations and field terminations shall be made with terminal blocks.
   d. Punch block terminations are not acceptable and shall not be allowed.
   e. Coaxial connectors shall be crimp-on and then soldered.
   f. Audio and control wires shall be terminated with crimp-on lugs, and then soldered.
   g. Bare wire shall be tinned prior to termination unless the connector manufacturer recommends otherwise.
   h. Unused line level shields shall be individually insulated using shrinkable tubing and attached to the cable using an additional piece of shrinkable tubing.

F. System Grounding:
1. The "spider" concept, as indicated in the grounding diagram, is designed to avoid ground loops and inductive coupling.
2. The systems shall be hum free, stable and free of oscillation with the earth ground temporarily disconnected.
3. The earth ground shall be made at only one point in the system as indicated and shall be in accordance with National Electric Code.
4. The grounding method shall insure that the system is free of the following problems under any mode of operation:
   a. RF oscillation, pickup and interference.
   b. Distortion.
   c. Crosstalk.

d. Signal Leakage.

e. Very high frequency feedback.

f. Audio Hum.

5. Major wiring ducts or trays in the Equipment Room(s) shall be grounded to the conduit system.

6. The equipment racks shall be isolated from, and not electrically connected to, the building grounding system. This means that the conduit system shall not be electrically connected to the equipment racks and that the equipment racks shall be installed so that they are electrically isolated from the building structural steel. The racks shall be electrically connected at only one point to the isolated grounding system as shown on the Category AV drawings.

G. Seismic Restraints:

1. Hanging or freestanding equipment and cabinets furnished by the Contractor (including but not limited to racks, loudspeakers, projection screens, and video displays) shall be secured to substantial building structure. Equipment shall resist seismic acceleration in any direction up to a limit of the greater of 1.0 G or the limit prescribed by the local governing codes.

2. Loudspeaker hanging details, rack bracing, and other seismic restraints are not shown on the contract drawings; it shall be the Contractor’s responsibility to develop these drawings and submit them as part of the shop drawings package for approval.

3. Submit the drawings to the Owner for review after they have been approved and signed by a certified structural engineer engaged in regular practice in the Project's State.

H. Loudspeaker Installation:

1. Verify loudspeaker aiming and positioning with Owner.

2. Submit loudspeaker mounting (rigging) drawings to the Owner for review after they have been approved and signed by a certified structural engineer engaged in regular practice in the Project's State.

I. Video Projector Installation:

1. The video projector shall be converged, registered and color balanced. At a minimum, the Contractor shall adjust and save the projector settings for standard scan rates and resolutions:

2. Submit video projector mounting drawings to the Owner for review after they have been approved and signed by a certified structural engineer engaged in regular practice in the Project's State.

3.02 SYSTEM PERFORMANCE TESTS:

A. General:

1. The Contractor shall pre-assemble and test systems and sub-systems in the Contractor’s facility before completed assemblies are delivery to the project site.

2. Tests shall include but are not limited to those listed below in order to verify that the system meets design requirements.

3. The Contractor shall perform the system testing and adjustment of the installed systems prior to scheduling the final system acceptance observations.

4. Tests shall be fully documented and a neat copy presented for review by the Owner during the acceptance observation and a copy of the test results shall be included in the system manual.

B. Performance Tests on Individual Components:
   1. Perform in the Contractor's facility.
   2. Verify that the manufacturer's specifications are met.
   3. Measure and record the impedance on each loudspeaker driver, and verify the acoustical output and freedom from rattles and distortion of loudspeakers.

C. Performance Tests on Completed Component Sub-assemblies:
   1. Perform in Contractor's facilities.
   2. Before delivery of the equipment to the project site, the Contractor shall demonstrate to Owner at the Contractor's facilities that sub-assemblies are operating as specified.
   3. Verify the achievement of the specifications for each electronic component in situ, i.e., as assembled in its console, rack or other enclosure, powered by the system power supply and with other components also activated, powered and interconnected. The magnitude and character of the threshold noise shall be observed for appearance of hum in excess of that present with individual activation, or the appearance of high frequency oscillation.
   4. Projection equipment shall be tested to verify that the manufacturer's specifications are met after it has been incorporated into a complete subassembly.
   5. Video equipment shall be tested to verify that its operation meets the manufacturer's specifications and EIA RS-170A after assembly into complete subsystems.

D. Performance Tests on the Complete System:
   1. Verify that wiring is correctly and completely installed. Verify that there are no short circuits between conductors within any cable, or from cable to cable. Verify the integrity of each conductor, i.e., that the conductor is not open circuited. In addition, the correct polarity of each connector, including those in patch panels, shall be verified and the color-coding scheme shall be recorded and included in the documentation provided to the Owner.
   2. Verify that the entire system performance is in accordance with the design requirements. Specific attention is directed to the following for each system:
      a. Projection Equipment.
      b. Videotape Transports.
      c. Video Switchers.
      d. Remote Control Components.
      e. Video Distribution Amplifiers.
      f. Audio Amplifiers.
      g. Consoles.
   3. The threshold noise output of the system, measured at the output of the power amplifier, must equal the input when its gain control is full on, and of the line or booster amplifier input when channel controls are off. No hum shall be audible in the system within the noise signal, or with the inputs terminated in microphone impedance and controls full on. No high frequency oscillation shall be observed at the system output. No audible radio signal shall be detectable in the system at any control setting. Depending upon the proximity of local radio stations or the cable configuration of the

system, RF oscillation or leakage may be a problem and the Contractor shall be prepared to install a RF low pass filter appropriately in the system as a final remedy.

4. Cross talk between channels shall be measured with signal equivalent to 1.0 Volts output into one channel with its gain off and the gain of each other channel varied over their full range. Maximum signal leakage at the system output must be equivalent to -70 dB re 1.0 Volt at the pre-amp output at 1 kHz, increasing to -52 dB at 8 kHz.
5. The general performance of each loudspeaker unit in situ shall be verified by applying pink noise signal at 10.0 Volt level and verifying the specified output SPL at a distance of 1 foot. Normal undistorted sound quality shall be verified by headphone listening at the output of the calibrated system. Each loudspeaker shall also be fed with an oscillator signal at 10.0 Volt level within its intended frequency range, verifying absence or abnormal distortion of rattles due to installation.

E. Optical projection system performance shall be in accordance with the following:
1. Projected images shall properly fill their respective screens to full size without "cropping".
2. Projection lenses shall provide distortion free images without color fringing or aberration.
3. Screen brightness and screen brightness ratio shall reasonably approach the theoretical value based on the projector's specified light output value with the necessary light loss corrections.
4. Equipment items shall be 100% tested for correct functional operation.

F. Digital Media System Testing:
1. The Contractor’s designated Digital Media Certified Engineer shall conduct the following tests on the Digital Media Transport systems and document the results in the As-Built document submittal.
2. Digital Media Hardware:
    a. For each component of the Digital Media hardware provide the Model Number, firmware version and IP address.
    b. For each switcher provide a table showing the input/output compatibility for the system.
3. Sources:
    a. Number of HDCP KSV keys supported by each permanent AV source.
    b. Video timing, HDCP usage and audio format for each permanent source.
    c. List of EDID video timings and audio formats presented to each source.
4. Output Devices:
    a. List of EDID video timings and audio formats supported by each output device.
5. System Infrastructure:
    a. Twisted Pair Cables:
        1) Length of cable run.
        2) Data rate supported each cable run.
    b. Fiber Cables:
        1) Length of cable run.
        2) Data rate supported each cable run.

G. Test results shall be recorded and provided as part of the As-Built Document Submittal.

H. These tests, and any others that the Contractor may wish for his own satisfaction, shall have been performed and successfully achieved before observation requested. The Owner's Representative may request repetition and demonstration during observation of certain of these tests or other critical tests if problems become apparent. If specifications are not met, further observations will be at the Contractor's expense.

3.03 DEMONSTRATION AND ACCEPTANCE OBSERAVTION

A. Acceptance Observation:

1. The Contractor shall file a written notice with the Owner when the aids to use described in paragraph 1.06, above, have been submitted for approval, tests described in paragraph 3.02, are complete and the systems and sub-systems are ready for the Acceptance Observation.
2. The Contractor shall be prepared to demonstrate the overall system performance including but not limited to functionality, control system programming, operation, optics performance and DSP software control (where applicable). In addition, the Observation of the systems may include repetition or demonstration of any tests described in Paragraph 3.02 above or other critical tests if problems become apparent and the specifications are not met. After the Observation, written notice noting whether the systems meet the criteria set forth in the Contract for Substantial Completion, along with a list of items for the Contractor to correct shall be provided to the Contractor.
3. Assist in the observation by performing demonstration tests and final system adjustments. Provide labor, materials and tools necessary for these tests and adjustments. Provide necessary test equipment to complete the tests.
4. If final acceptance is delayed because the system(s) are not in proper working order or are incomplete, the Contractor shall pay for additional time and expenses for any resultant extension or re-scheduling of the acceptance observation.
5. Any measurements of frequency response, distortion, noise or other characteristics and any adjustments deemed necessary may be performed on any item or group of items, including re-orientation of loudspeakers, to insure optimum performance of the system.

B. Contractor Participation in the Observations:

1. The Contractor shall make two representatives: the Project Engineer and a technician available during the system observation. They shall assist the Owner’s Representative in performing the observations. Their assistance shall include demonstrating the performance of the system by carrying out tests on the system as directed by the Owner’s Representative and making any final system adjustments as deemed necessary.
2. The Contractor shall provide labor, materials and tools necessary to repeat or carry out any tests on the system during the observations and to make any adjustments to the system during the inspections.
3. The Contractor shall budget 8 hours to provide assistance during the observations. If additional time is required for the observations because the system installation is not complete or system testing or adjustment has not been completed, the Contractor shall solely bear the cost of providing additional man hours necessary to complete the inspections.
4. System testing and adjustment shall be completed prior to the observations. If final acceptance is delayed because the installation is not in proper working order or is

incomplete, the Contractor shall pay for additional time and expenses for any resultant extension or re-scheduling of the acceptance testing period.

C. Acceptance:

1. After observations and tests indicate that the entire system and sub-systems as specified herein and indicated on the drawings are in total compliance with the drawings and specifications, a letter indicating said compliance shall be issued.
2. Acceptance of the system shall be accomplished as described in the Contract.
3. Final acceptance of the installation will be granted when it is clear to the Owner that the following conditions have been met:
    a. Fixed equipment has been furnished and installed according to the drawings and specifications.
    b. Portable equipment has been turned over to the Owner.
    c. Equipment and installation have been tested and shown to perform as specified.
    d. Instruction manuals, software source code and as-built documentation have been completed and delivered to the Owner's Representative.
4. The Warranty period will begin only when the above listed items have been preformed to the satisfaction of the Owner and Consultant.

3.04 CLEANING

A. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of the equipment. Remove construction debris from equipment area and dispose of properly.

3.05 TRAINING

A. Submit training materials to the Owner's representative for approval prior to scheduling training sessions.

B. Provide 8 hours of hands on training practical operation of the system to the Owner's Representative. Address in the training, the general configuration of the system, basic functionality, correct operation procedures, routine maintenance and upkeep.

1. Provide instruction in operation of the CAM and connection to the system.
2. Provide instruction in connection of OFE portable mixer to system.

C. Videotape training sessions and provide 3 edited copies to the Owner on DVD format.

END OF SECTION