



MRWMD

Monterey Regional Waste Management District

Truck Yard and CNG Fueling Facility

For:
**Monterey Regional Waste
Management District**
14207 Del Monte Blvd
Marina, CA 93933

Project Specifications

J.R. MILLER & ASSOCIATES, INC.

Corporate Office

2700 Saturn Street

Brea, CA 92821

Tel: 714.524.1870

Fax: 714.524.1875

Date	Description
10/20/14	BID SET

128 East Reynolds Road, Ste. 101

Lexington, KY 40517

Tel: 859.245.0049

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www.jrma.com

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END OF DOCUMENT

Document 001116

INVITATION TO BID

PROJECT: Truck Yard Project
Monterey Peninsula Landfill
Marina, California 93933-1670
Monterey County, California

OWNER: Monterey Regional Waste Management District
Project Manager: Richard D. Shedden, P.E.
<mailto:rshedden@mrwmd.org>
14201 Del Monte Boulevard
P.O. Box 1670
Marina, California 93933-1670
Phone: (831) 384-5313
Fax: (831) 384-3567

ARCHITECT/
ENGINEER JR Miller & Associates, Inc.
Project Manager: Kyle Rausch
kylar@jrma.com
2700 Saturn Street
Brea, California 92821
Phone: (714) 524-1870

CALL FOR BIDS

The Monterey Regional Waste Management District (MRWMD) is inviting bids on a General Contract for the construction of a Truck Yard and CNG Fueling Facility at the Monterey Peninsula Landfill, a Class III municipal solid waste landfill. The landfill is located on MRWMD-owned property at the Monterey Regional Environmental Park, 14201 Del Monte Blvd., 2 miles north of the City of Marina.

RECEIPT OF BIDS

Sealed bids will be received at the office of the MRWMD, located at 14201 Del Monte Blvd., P.O. Box 1670, MARINA, CA 93933 until **2:00 p.m., Monday, November 24, 2014** at which time they will be publicly opened and read. Any bids received after that time will not be considered. Oral, telephonic, facsimile, or telegraphic bids are invalid and will not receive consideration.

DESCRIPTION OF WORK

Work involves construction of, but not limited to, (1) approximately 11.58 acres of grading including two large retention ponds and a bioswale with small retention pond, (2) construction of three buildings (7,200 SF Administration Building; 11,300 SF Service Bay Building; 5,500 SF Truck/Bin Wash Building), (3) a fire storage tank and associated piping to connect to the existing fire water storage tank system to supply fire hydrants throughout proposed site, (4) connection of domestic water to existing well including a water storage tank and associated support equipment, (5) installation of landfill gas monitoring under all three proposed buildings, (6) approximately 6 acres of asphalt and hard surfacing with supported storm drainage system, (7) perimeter security fencing and rolling gates, (8) CNG fueling island with access drive, and (9) coordination of CNG fueling stations, both fast and slow fill systems with supporting equipment. The work also includes subgrade preparation and placement of engineered fill.

BID DOCUMENTS

Copies of the Bid Documents (including plans, specifications, contract forms, bid forms and conditions) may be obtained on or after October 24, 2014 at the ARC Reprographics Store in Monterey by purchasing a non-refundable payment for each set needed. Electronic format of the Bid Documents can be obtained from ARC Reprographics for the cost charged by ARC. Contact information for ARC Reprographics: 2 Harris Court, Unit A-5, Monterey, California 93940; tel: (831) 646-1170 / fax: (831) 646-5165. Upon request from contractor, a link can be provided to review Bid Documents on the ARC Reprographics PlanWell database. Bid Documents will also be available on the Salinas Valley Builders Exchange (590-A Brunken Avenue, Salinas, CA 93901 / 831) 758-1624 / Contact Christie Cromeenes, Executive Director / www.svbe.com). Bids shall be submitted on the Bid Forms provided with the Bid Documents. Bid Documents and supplemental information for bidders, such as reports of geological information, soils testing data, etc., are available for examination without charge at the MRWMD office.

BID GUARANTY

Each bid shall be accompanied by a certified or cashier's check or bid bond in the amount of 10 percent of the total bid price payable to the MRWMD as a guaranty that the bidder, if his proposal is accepted, will promptly execute the contract, secure payment of worker's compensation insurance, and furnish a satisfactory faithful performance bond in the amount of 100 percent of the total bid price.

WAGE RATES

Pursuant to Section 1770 and the following sections of the California Labor Code, the contractor shall pay not less than the prevailing rate of per diem wages as determined by the California Department of Industrial Relations for projects in Monterey County.

COMPLETION OF WORK

All contract work for underground utilities, infrastructure, and etc beneath the proposed asphalt truck parking areas, associated access roads (including the northern-most CNG Fast Fueling access) must be completed by May 1, 2015 after the Notice-to-Proceed is issued by the MRWMD. The truck parking and use of the CNG fueling stations are critical to the MRWMD lease agreement between MRWMD and their Truck Hauling Tenant. All remaining contract work must be completed within two hundred and twenty eight days (228) calendar days after the Notice-to-Proceed is issued by the MRWMD.

MANDATORY PRE-BID CONFERENCE

All prospective general contract bidders are required to attend a pre-bid conference to be held at the MRWMD office at 10:00 a.m., November 3, 2014. Representatives of the MRWMD and JR Miller & Associates, Inc. will be in attendance. The conference will be followed by a tour of the construction site.

PROJECT ADMINISTRATION

All Questions relative to this project prior to the opening of bids shall be directed to:

Kyle Rausch, Project Manager, JR Miller & Associates at (714) 524-2870, *and*
Richard D. Shedden, P.E., Monterey Regional Waste Management District at (831) 384-5313.

The successful bidder must be licensed in the State of California and must demonstrate acceptable experience of the type of work described in the Bid Documents. The MRWMD reserves the right to waive any irregularities and to reject any or all bids.

END OF DOCUMENT

Document 002113

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS

- A. Terms used in these Instructions to Bidders and in other Bid Documents which are defined in the General Conditions and Supplementary Conditions have the meanings assigned to them therein.
- B. The "Project Manual" comprises the Contract Documents and the following: Invitation to Bid, Instructions to Bidders, Bid Form, Bid Schedule, Bid Bond, Bidder's Qualification Affidavit, List of Proposed Subcontractors, Labor and Equipment Rate Schedules, Contractor's License Form, and any other forms designated to be attached to the Bid Form.

2. INFORMATION FOR BIDDERS

- A. Supplemental Information for Bidders may be examined at the office of the OWNER and includes geological, hydrological and design documents. These documents are listed by name in Section 002114 of the Project Manual.
- B. Soil laboratory data.
- C. Disclaimer:
 - 1. The information contained in the above-referenced documents is being made available to the Bidder solely for his information and convenience. The information and data contained in the above-referenced documents does not constitute a part of the Contract.
 - 2. Neither the OWNER nor the ARCHITECT/ENGINEER represent that the information being made available shows the complete range of conditions which will be encountered in the construction of the project. The information concerning geological and other subsurface conditions furnished in the referenced document represents only the opinion of the OWNER and the ARCHITECT/ENGINEER as to the character of the materials encountered during field investigations.
 - 3. The OWNER and the ARCHITECT/ENGINEER disclaim responsibility for any opinions, conclusions, interpretations, or deductions that may be expressed or implied in any of the information and data contained in the referenced documents, it being expressly understood that the making of

deductions, interpretations, and conclusions is the Bidder's or CONTRACTOR'S sole responsibility.

3. EXAMINATION OF PROJECT MANUAL, SITE, AND CONDITIONS OF WORK

- A. The Project Manual includes the most recent editions of the following documents and any other additional documents as issued by the OWNER and/or ARCHITECT/ENGINEER.
 - 1. Bound herein
 - a. Bidding Requirements
 - b. Contract Forms
 - c. Terms and Conditions
 - d. Specifications
 - 2. Bound separately
 - a. Construction Drawings
 - b. Construction Quality Assurance Plan
- B. Before submitting a Bid, each Bidder shall (a) examine the Project Manual thoroughly; (b) visit the site to familiarize himself with local conditions that may in any manner affect cost, progress or performance of the Work; (c) familiarize himself with federal, state and local laws, ordinances, rules and regulations that may in any manner affect cost, progress or performance of the Work; and (d) study and carefully correlate Bidder's observations with the Project Manual.
- C. Before submitting his Bid, each Bidder shall, at his own expense, make such additional investigations and tests as the Bidder may deem necessary to determine his Bid for performance of the Work in accordance with the time, scope or work, and other terms and conditions of the Project Manual. On request, OWNER will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of his Bid.
- D. The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in the Supplementary Conditions, General Requirements or Drawings.

- E. The submission of a Bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this Article 3 and that the Project Manual is sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.
- F. Complete sets of Bidding Documents shall be used in preparing Bids; neither OWNER nor ARCHITECT/ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents
- G. OWNER and ARCHITECT/ENGINEER, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

4. QUALIFICATIONS OF BIDDERS

- A. Contractors shall be properly qualified and licensed in accordance with the laws of the State of California, as applicable. Any individual, firm, or corporation acting as prime contractor and making, filing, or financially interested in more than one Bid for the same work will be disqualified. This does not apply to material suppliers or to subcontractors making proposals to general contractors.
- B. Bidders are required to complete the "Bidder's Qualification Affidavit" and "Contractor's License Form" and to submit them with their Bids as hereinafter specified. The OWNER may make such additional investigations as he deems necessary to determine the ability of any Bidders to perform the work, and the Bidders shall furnish to the OWNER such additional information and data for this purpose as the OWNER may request.
- C. Either the Bidder or his subcontractor shall be fully qualified to perform the installation of proposed project. Such qualification shall include satisfactory experience in the construction of the proposed facility of similar size, scope and magnitude. The Bidder's or subcontractor's experience in this field shall be fully documented in the "Bidder's Qualification Affidavit."
- D. The OWNER, by its sole determination, reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the OWNER that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work in accordance with the Project Manual. Conditional Bids will not be accepted.
- E. In accordance with the provisions of the Business and Professions Code Section 7028.15, the OWNER has determined that the CONTRACTOR shall possess a valid Class A (General Engineering Contractor) Contractor's License at the time the bid

is submitted. Failure to possess the specified license shall cause the Bid to be rejected as being nonresponsive. The OWNER, before awarding the Bid, will verify that the CONTRACTOR was properly licensed at the time of bid submittal.

5. INTERPRETATIONS OF THE PROJECT MANUAL

- A. Every request for an interpretation of the Project Manual shall be in writing and, to be considered, must be received by the ARCHITECT/ENGINEER at least 12 calendar days before the date set for the opening of Bids.
- B. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the Project Manual. All such written addenda shall become a part of the Project Manual.
- C. Addenda, if any, will be mailed to all planholders at the respective addresses furnished for such purposes. Failure of any Bidder to receive any such addendum shall not relieve such Bidder from any obligation under his Bid as submitted.
- D. The OWNER and ARCHITECT/ENGINEER assume no responsibility for clarifications or interpretations of the Project Manual arrived at in any other manner.
- E. Any discrepancies or omissions in the Project Manual discovered by the Bidder shall be called to the attention of the ARCHITECT/ENGINEER during the Bidding period.
- F. The right is reserved by the OWNER to revise or amend the Project Manual prior to the date set for opening of Bids. Such revisions and amendments, if any, will be announced by written addenda. Copies of such addenda will be furnished to all registered Bidders as specified above. If the revisions and amendments are of a nature which requires substantial changes in quantities and prices, or either of them, the date set for opening of Bids may be postponed by such a number of days as the OWNER will determine to be necessary to enable Bidders to revise their Bids. In such cases, addenda will include announcement of the new date for opening of Bids.

6. PREPARATION OF BID

- A. The Bid:
 - 1. The following documents shall comprise the CONTRACTOR'S Bid and shall be submitted:
 - a. Bid Form (Document 004113)

- b. Bid Bond (Document 004313)
 - c. Bidder's Proposed Construction Schedule (Document 004150)
 - d. List of Proposed Subcontractors (Document 004200)
 - e. Bidder's Qualification Affidavit (Document 004250)
 - f. Bidder's Proposed Equipment (Document 004300)
 - g. Labor and Equipment Rate Schedules (Document 004400)
 - i. Contractor's License Form (Document 004500)
2. A copy of the foregoing documents is bound herein, and Bids shall be prepared on extra copies of these documents copied by the Bidder.
 3. Each of the documents comprising the CONTRACTOR'S Bid, as listed above, shall be filled in and completed in its entirety. The documents shall be completed in ink or by typewriter. Interlineations, alterations, or erasures shall be initialed. All blank spaces shall be filled in. Where any item or items in the documents are not applicable to the Work, then the words "none" or "not applicable" shall be filled in as appropriate.
 4. If any of the foregoing documents are not completed, the Bid may be considered unresponsive and rejected.
- B. Addenda: Receipt of all addenda issued shall be acknowledged. If no addenda were issued or received, "none" shall be written in.
- C. Bid Security:
1. Each Bid shall be accompanied by a certified check or cashier's check made payable to the OWNER, or a Bid Bond prepared on the Bid Bond form bound in with this Project Manual, duly executed by the Bidder as principal, and having as surety thereon a surety company licensed to do business in the State of California and approved by the OWNER, in an amount not less than 10 percent of the Bid.
 2. Checks submitted as bid security will be returned to all Bidders, except the three lowest Bidders, within 10 calendar days after the opening of Bids, and the remaining checks will be returned promptly after the OWNER and the accepted Bidder have executed the Contract (Agreement). Bid bonds will be returned only upon request and only to bidders not in contention for award of the Contract.

3. The successful Bidder, upon his failure or refusal to execute and deliver the Contract (Agreement) and the bond(s) required within 10 calendar days after he has received Notice of Award of the Contract, shall forfeit to the OWNER, as liquidated damages for such failure or refusal, the security deposited with his Bid.
4. The Bid Bond shall remain in effect for a minimum period of 60 calendar days from the date of the opening of the Bids.

D. List of Proposed Subcontractors:

1. Bidders shall list the various classes of work included in the Project and the names and business addresses of the subcontractors and material and equipment suppliers proposed to perform work, furnish materials or equipment, or render service on or about the Project in excess of 5 percent of the amount of the Bid Price. Work in excess of 5 percent of the Bid Price for which a subcontractor is not listed will be presumed to be performed by the Bidder.
2. Bidders shall fill in and complete the List of Proposed Subcontractors in the Form provided to fulfill the foregoing requirements. If space is not sufficient as provided in the Form, Bidder may add a separate sheet or sheets.
3. Substitution of subcontractors after bid opening will require approval of the OWNER.

E. Substitutions of Materials:

1. Bids shall be submitted on the basis of the Project Manual as prepared by the ARCHITECT/ENGINEER. Consideration of substitute "or equal" items of materials or equipment will be postponed until the apparent low Bidder has been identified.
2. All matters relating to substitute "or equal" items shall be concluded after the bid opening and prior to installation of any proposed equals in accordance with the procedures described in Section 01630, Product Options and Substitutions.
3. Requests for substitutions will be handled as specified in Section 012500, Product Options and Substitutions.

F. Signing of the Bid Form:

1. Bidders shall properly date and sign the Bid. In the case of a corporation, a duly authorized officer of the corporation shall sign; in the case of a partnership, a partner shall sign; in the case of a joint venture, a duly authorized officer of the sponsoring member shall sign, and in the case of an individual, such individual shall sign. Satisfactory evidence of the authority of the signatory on behalf of the Bidder shall be furnished.
 2. Under the signing provisions of the Bid Form, all spaces provided shall be filled in as applicable. Corporations shall affix their seal where shown.
- G. Bid Schedule: Bidders shall complete the Bid Schedule as provided. All blank spaces shall be filled in. The total of the Bid Schedule shall be entered in the Bid Form in the space provided therein.

7. FILING OF BID

- A. Each Bid shall be submitted in a sealed envelope bearing on the outside the name of the Bidder, his address, the name of the Project, the title of the Project Manual for which the Bid is being submitted, and the time and date of the Bid opening. If forwarded by mail, the sealed envelope containing the Bid shall be enclosed in another envelope addressed to the OWNER.
- B. It is intended that Bids received prior to the time set for the Bid opening will be securely kept, unopened; but the OWNER shall in no event be liable for the premature opening of any Bid.
- C. Written modifications of Bids already submitted will be considered if received prior to the Bid opening.
- D. Any Bid may be withdrawn prior to the scheduled time for the opening of Bids, or authorized postponement thereof, upon signed written or telegraphic request delivered to the OWNER. Any Bid received after the time and date of the Bid opening will not be considered. No Bidder shall withdraw his Bid after the scheduled date and time of opening thereof. Negligence on the part of the Bidder in preparing the Bid confers no right for withdrawal of the Bid after it has been opened.

8. EVALUATION OF BIDS AND AWARD OF CONTRACT

- A. OWNER reserves the right to reject any and all Bids, to waive any and all irregularities, to negotiate contract terms with successful Bidder, and the right to disregard all nonconforming, nonresponsive or conditional Bids. Discrepancies between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof

will be resolved in favor of the correct sum. In case of discrepancy between unit prices and extended amounts, the unit prices shall prevail and, for bid evaluation purposes, the extended amounts will be adjusted accordingly.

- B. In evaluating Bids, OWNER will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and alternatives and unit prices if requested in the Bid forms.
- C. OWNER may consider the qualifications and experience of subcontractors and other persons and organizations (including those who are to furnish the principal items of material or equipment) proposed for those portions of the Work as to which the identity of subcontractors and other persons and organizations must be submitted as provided in the Supplementary Conditions. Operating costs, maintenance considerations, performance data and guarantees of materials and equipment may also be considered by OWNER.
- D. OWNER may conduct such investigations as he deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of the Bidders, proposed subcontractors and other persons and organizations to do the Work in accordance with the Project Manual to OWNER'S satisfaction within the prescribed time.
- E. OWNER, by its sole determination, reserves the right to reject the Bid of any Bidder who does not pass any such evaluation to OWNER'S satisfaction.
- F. If the Contract is to be awarded, it will be awarded to the lowest responsive Bidder whose evaluation by OWNER indicates to OWNER that the award will be in the best interests of the Project.
- G. If the Contract is to be awarded, OWNER will give the successful Bidder a Notice of Award within 21 calendar days after the day of the Bid opening.
- H. The OWNER will issue a Notice of Award, which the successful Bidder will be required to sign and return within 10 calendar days. The Notice of Award will authorize the CONTRACTOR to proceed with obtaining the bond(s) and the various insurances and certificates which are required to be submitted with the signed Contract.
- I. The OWNER will issue the OWNER'S form of construction Contract (Agreement) concurrently with the Notice of Award. The CONTRACTOR will be required to execute and return the Contract within 10 calendar days after receipt of the Contract for signing. Upon receiving the Contract, signed and returned by the CONTRACTOR, along with the required bond(s) and certificates of insurance, the

OWNER will sign and return one executed copy of the Contract to the CONTRACTOR within 10 calendar days.

- J. If the award is made to a corporation, the corporation will be required to furnish evidence of its corporate existence and of its right to do business in the State of California, and of the authority of the officers signing the Contract.

9. OWNER AND ARCHITECT/ENGINEER

- A. For the purposes of administration of the Contract, the OWNER is as follows:

Monterey Regional Waste Management District
P.O. Box 1670
14201 Del Monte Boulevard
Marina, California 93933-1670
Attention: Mr. Richard D. Shedden, P.E.
Telephone: (831) 384-5313
Fax: (831) 384-3567

- B. For purposes of administration of the Contract, the ARCHITECT/ENGINEER is as follows:

JR Miller & Associates, Inc.
2700 Saturn Street
Brea, California 92821
Attention: Mr. Kyle Rausch
Telephone: (714) 524-1870
Fax: (714) 524-1875

10. CORRESPONDENCE INSTRUCTIONS

- A. Correspondence relating to engineering and all correspondence prior to an award shall be sent in triplicate to the ARCHITECT/ENGINEER.
- B. Subsequent to notification of an award, the successful Bidder shall send all correspondence relating to price, terms, or schedules to the OWNER in triplicate, with a copy to the ARCHITECT/ENGINEER.
- C. The OWNER reserves the right to designate additional persons and locations to which copies of all correspondence relating to the work shall be sent by the CONTRACTOR.

END OF DOCUMENT

Document 002114

INFORMATION AVAILABLE TO BIDDERS

1.0 AVAILABILITY

- A. The information described in this document is available for viewing at the Monterey Regional Waste Management District office, 14201 Del Monte Boulevard, Marina, California, 93933-1670, Mondays through Fridays, from 8:00 a.m. to 5:00 p.m.

2.0 BIDDER RESPONSIBILITIES

- A. The OWNER or ARCHITECT/ENGINEER shall not be responsible for the accuracy or completeness of such information. Responsibility for the accuracy of the information lies with the preparer.
- B. Bidder shall have full responsibility for the interpretation of the information for his bidding and construction purposes.
- C. Bidder shall have full responsibility for reviewing and verifying such information, for locating underground facilities or existing structures shown or indicated in the Contract Documents, and for coordination of the Work with the owners of such underground facilities or existing structures during construction.

3.0 REPORTS, ETC

- A. "Design Basis Memorandum for the Truck Yard Project, Monterey Peninsula Landfill, 14207 Del Monte Boulevard, Marina, CA 93933, Monterey County, California" by JR Miller & Associates, 2014
- B. "Geotechnical Investigation Report For Truck Yard Project" by Golder & Associates, 2014.
- C. "Initial Study / Negative Declaration documents" by Denise Duffy & Associates, 2014.
- D. "Project Schedule" by JR Miller & Associates, 2014.
- E. Monterey County requires special inspection by testing agencies, which they have compiled a list of approved companies to perform the required inspections. "Approved Special Inspection Agency List" by Monterey County, 2013. Contractor shall provide preferred Special Inspection Company selections to MRWMD for reference.

4.0 GEOLOGIC / HYDROGEOLOGIC INFORMATION

- A. Bidder is made aware that minor quantities of municipal solid waste may be encountered during excavation and construction of the Truck Yard Project.

END OF DOCUMENT

DOCUMENT 003113 - PRELIMINARY SCHEDULE

1.1 PROJECT SCHEDULE

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but do not affect Contract Time requirements. This Document and its attachments are not part of the Contract Documents.
- B. Available Project information includes the following:
 - 1. Project Design Schedule.
- C. Project schedule including design and construction milestones is available for viewing at the MRWMD property and/or on Project Web site.
- D. Related Requirements:
 - 1. Document 004113 "Bid Form" for Contract Time.
 - 2. Section 001116 "Bid Invite"
 - 3. Section 005000 "Agreement Between MRWMD and Contractor"

END OF DOCUMENT 003113

Document 004113

BID FORM

To: Richard D. Shedden, P.E.
Monterey Regional Waste Management District
14201 Del Monte Boulevard
P.O. Box 1670
Marina, California 93933-1670

Project: Truck Yard Project
14207 Del Monte Boulevard
Marina, California 93933

Bid Due Date: November 24, 2014 at 2:00 p.m.

Bidder: _____

PART 1 OFFER

Having examined the place of the Work and all matters referred to in the Bid Documents for the named Project, we the undersigned hereby offer to enter into a Contract to perform the Work for the Bid Price of

_____ Dollars (\$ _____)

Lump Sum Contract. If the Bid is for a single Lump Sum Contract, the Bid Price above is the Total Stipulated Price offered including Allowances, if any.

Alternate Bids. We will perform Alternate Bid Work described in the Bid Documents for an amount added to the Bid Price for each Alternate Bid that is accepted by the OWNER.

Period for Bid Acceptance. This offer shall be open to acceptance and is irrevocable for 90 calendar days from the Bid due date. That period may be extended by mutual written agreement of the OWNER and the Bidder, or as needed to fulfill requirements for Agreement submittals, as discussed in Document 00450 - Contractor's License Form. After the Bid Acceptance Period, the Bidder may withdraw without penalty if no mutual agreement can be reached.

PART 2 CONTRACT TIME

If this offer is accepted, we shall meet the following schedule:

- Notice to Proceed – _____

- Start Work on or before – _____
- Substantial Completion of Excavation – _____
- Substantial Completion of HDPE Liner – _____
- Substantial Completion of Entire Project – _____
- Final Completion of Entire Project – _____

The CONTRACTOR shall perform the contract work between the hours of 6 AM and 6 PM, Monday through Saturday. No work shall be performed on Sundays and national holidays, without the written permission of the OWNER.

The CONTRACTOR’S construction schedule (Document 004150) submitted with his bid shall account for and identify the total number of working days assumed to develop his bid for each month of work. The CONTRACTOR’S schedule shall account for the anticipated normal weather condition.

PART 3 ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted therein have been considered and all costs relating thereto are included in the Bid Price:

- | | |
|---------------------------------|---------------------------------|
| Addendum No. _____, dated _____ | Addendum No. _____, dated _____ |
| Addendum No. _____, dated _____ | Addendum No. _____, dated _____ |
| Addendum No. _____, dated _____ | Addendum No. _____, dated _____ |

PART 4 ATTACHMENTS TO THIS BID

The following required Attachments to this Bid provide information which may be used by the OWNER for the evaluation of the Bid:

- [] Document 00405 - Schedule of Unit Price Work
- [] Document 004313 - Bid Bond
- [] Document 004150 - Bidder Proposed Construction Schedule
- [] Document 004200 - List of Proposed Subcontractors
- [] Document 004250 - Bidder Qualification Affidavit

- [] Document 004300 - Bidder Equipment
- [] Document 004400 - Labor and Equipment Rate Schedule
- [] Document 004500 - Contractor License Form

PART 5 PENALTY FOR DELAY

We agree that time is of the essence and that we will pay the OWNER delay penalties in accordance with Paragraph 9.11 of the Supplementary Conditions if we fail to meet any of the Substantial Completion or Final Completion dates specified in the Contract Times on this Bid Form.

PART 6 SIGNATURES:

Bidder: _____
 (Please print or type the full legal name of your proprietorship, partnership, corporation or joint venture. *)

By: _____
 (Signature of sole proprietor, partner, or authorized officer of corporation.)

Name: _____
 (Please print or type name.) (Title)

Address: _____
 (Business Address of Bidder, print or type.)

Telephone: _____
 (Print or type telephone number.)

- ()
- ()
- (Corporate)
- (Seal)
- ()

()

Attest: _____

(Corporate Secretary)

**If the Bid is a joint venture, add additional Bid Form (Document 004113 - Bid Form) signature sheets for each member of the joint venture.*

END OF DOCUMENT

Document 004150

BIDDER'S PROPOSED CONSTRUCTION SCHEDULE

- 1.00 This Document 004150 constitutes an Attachment to Document 00300 - Bid Form.
- 2.00 The information provided by the Bidder in this Document will be one component which OWNER may use to evaluate the Bid.
- 3.00 Bidder proposes the following construction schedule for the major items of the Work. A construction schedule outline in the format of Bidder's choice is attached:

Yes No

<u>ACTIVITY</u>	<u>START DATE</u>	<u>COMPLETION DATE</u>

- 4.00 Upon award of the Contract, the successful Bidder will be required to prepare and submit a construction schedule for the Work to the detail required by OWNER'S Project Manager, in accordance with Paragraph 3.11.1 of Document 007000 - General Conditions.

END OF DOCUMENT

Document 004200

LIST OF PROPOSED SUBCONTRACTORS

1.01 GENERAL

- A. This Document 004200 - List of Proposed Subcontractors constitutes an Attachment to Document 004113 - Bid Form
- B. The Bidder shall list the names and business addresses on the following form of the subcontractors and material suppliers that he proposes to use to perform work or render service on or about the Project for the various portions of the Work that are in excess of five percent of the amount of the Bid Price.
- C. If no subcontractor is listed, it will be assumed that the CONTRACTOR will do all work as specified.
- D. No SUBCONTRACTORS other than those listed herein will be allowed to perform work under this contract. Substitutes will only be permitted with written approval of OWNER.
- E. The CONTRACTOR and all SUBCONTRACTORS shall have a valid contractor's license for the class of work to be performed prior to the award of the contract.

LIST OF PROPOSED SUBCONTRACTORS

No.	Class of Work/Material Subcontractor/Material Supplier	Name of Subcontractor/Material Supplier	Address of
1.			
2.			
3.			
4.			
5.			
6.			
7.			

8.

9.

Attach experience record and reference of subcontractor (or other affiliate). Use additional sheets if required.

END OF DOCUMENT

Document 004250

BIDDER'S QUALIFICATION AFFIDAVIT

This Document 004250 - Bidder's Qualification Affidavit constitutes an Attachment to Document 004113 - Bid Form.

THE UNDERSIGNED CERTIFIES under oath the truth and correctness of all statements and of all answers to questions made hereinafter.

Submitted To: Monterey Regional Waste Management District
14201 Del Monte Boulevard
P.O. Box 1670
Marina, California 93933-1670

Submitted By: _____

Bidder's Legal Name: _____

Address: _____

Main Office: _____

1. How many years has your organization been in business as a general contractor?

2. How many years has your organization been in business under its present business name? _____

3. If a corporation, answer the following:

a. Date of incorporation: _____

b. State of incorporation: _____

c. President's name: _____

d. Vice-president's name(s): _____

e. Secretary's name: _____

f. Treasurer's name: _____

4. If individual or partnership, answer the following:

a. Date of organization: _____

b. Name and address of all partners.

(State whether general or limited partnership):

5. If other than corporation or partnership, describe organization and name principals:

6. We normally perform _____ % of the work with our own forces. The work we perform with our own forces, listed by trades, includes the following:

(Attach additional sheets if necessary)

7. Have you ever failed to complete any work awarded to you? _____
If so, note when, where and why:

8. Has any officer or partner of your organization ever been an officer or partner of another organization that failed to complete a construction contract? _____ If so, state circumstances:

9. List name of project, owner, architect/engineer, contract amount, percent complete, and scheduled completion of the major construction projects similar in type to the work described in this Project Manual, that your organization has in progress on this date:

10. List the name of the project, owner, architect/engineer, contract amount, date of completion, and percent of work with own forces of the major projects your organization has completed in the past ten years. State those projects which involved similar scope and magnitude to the Monterey Peninsula Landfill. To be qualified for award of the contract, the Bidder must have acceptable experience in earthwork , site preparation work, and proposed facility construction.

11. List the construction experience of the principal individuals of your organization, indicating the alternative candidates whom you expect to make available for assignment as Project Manager or Project Superintendent.

12. List states and categories in which your organization is legally qualified to do business:

13. Construction industry references:

14. Bank references:

15. Name of bonding company and name and address of agent:

16. Attach Statement of Financial Conditions, including Bidder's latest annual financial statement with quarterly supplements to date, prepared in accordance with generally accepted accounting principles.

Dated at _____, _____,

this _____ day of _____, 20 _____.

Legal Name of
Organization: _____

By: _____
(Signature)

Title: _____

()
()
(Corporate)
(Seal if a)
(Corporation)
()
()

M _____, being duly
sworn, deposes and says that he (she) is the _____
of _____ (Contractor's, Organization or Firm),
and that the answers to the foregoing questions and all statements therein contained are true
and correct.

Subscribed and sworn before me this _____ day of _____, 20 _____.

Notary Public: _____

My Commission Expires: _____

END OF DOCUMENT

Document 004300

BIDDER'S PROPOSED EQUIPMENT

- 1.00 This Document 004300 Bidder's Proposed Equipment constitutes an Attachment to Document 004113 - Bid Form.
- 2.00 The information provided by the Bidder in this Document will be one component which OWNER may use to evaluate the Bid.
- 3.00 Bidder proposes to use the following major equipment to perform the Work.

EQUIPMENT LIST

TYPE OF EQUIPMENT (E.G. EXCAVATOR)	MAKE AND MODEL (E.G. CAT 330)	NUMBER OF UNITS

END OF DOCUMENT

Document 004313

BID BOND

This Document 004313 - Bid Bond constitutes an Attachment to Document 004113 - Bid Form.

KNOW ALL MEN BY THESE PRESENTS, that we _____

as Principal, hereinafter called the Principal, and _____

a corporation duly organized under the laws of the State of _____ as Surety,
hereinafter called the Surety, are held and firmly bound unto:

Monterey Regional Waste Management District
14201 Del Monte Boulevard
P.O. Box 1670
Marina, California 93933-1670

as Obligee, hereinafter called the Obligee, in the sum of _____
Dollars (\$ _____), or 10 percent of the total of the bid, for the payment of which
sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs,
executors, administrators, successors and assigns, jointly and severally, firmly by these
presents.

WHEREAS, the Principal has submitted a Bid for all Work required to complete the Contract for
Truck Yard Project Construction for the Monterey Peninsula Landfill, in accordance with the
Project Manual prepared by JR Miller & Associates, 2700 Saturn Street, Brea, California 92821.

NOW, THEREFORE, if the Obligee shall accept the Bid of the Principal and the Principal shall
enter into a Contract with the Obligee in accordance with the terms of such Bid, and give such
bond or bonds as may be specified in the Project Manual with good and sufficient surety for the
faithful performance of such Contract and for the prompt payment of labor and material
furnished in the prosecution thereof, or in the event of the failure of the Principal to enter into
such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the
difference not to exceed the penalty hereof between the amount specified in said Bid and such
larger amount for which the Obligee may in good faith contract with another party to perform
the Work covered by said Bid, then this obligation shall be null and void, otherwise to remain in
full force and effect.

Signed this _____ day of _____, 20_____.

Witness: _____ Principal: _____

()
()
(Corporate)
(Seal)
()
()

By: _____

Title: _____

Legal Address: _____

Attest: _____
(Corporate Secretary)

Witness: _____ Surety

: _____

()
()
(Corporate)
(Seal)
()
()

By: _____

Title: _____

Legal Address: _____

Attest: _____
(Corporate Secretary)

END OF DOCUMENT

Document 004400

LABOR AND EQUIPMENT RATE SCHEDULES

1.01 GENERAL

- A. This Document 004400 - Labor and Equipment Rate Schedules constitutes an Attachment to Document 004113 - Bid Form.
- B. The labor and equipment rate schedules shall be used in conjunction with the work that may be authorized by the OWNER under Lump Sum Contract with Allowances. The rates shall be used to determine compensation to be paid to the CONTRACTOR.
- C. The information included in this Section shall be supplemental to the provisions of Article 11 of the General Conditions.
- D. Labor and equipment rates presented shall remain frozen for the term of the Project.

1.02 LABOR RATE SCHEDULE

- A. The Bidder shall provide regular hourly rates and overtime hourly rates in \$/hr. for each class of labor that the Bidder expects to use on the Project and for each class of labor that the Bidder has available that may be used on the Project.
- B. The rates shall be provided in the format included on the following Labor Rate Schedule.

1.03 EQUIPMENT RATE SCHEDULE

- A. The Bidder shall, for each type and class of equipment, provide regular hourly rates in \$/hr. and cost for mobilization and demobilization to the site. The rates shall be provided for the equipment that will be used during this Contract and for equipment that may have to be mobilized to perform the Work of this Contract. Rate includes equipment, operator and consumables such as fuel.
- B. The rates shall be provided in the format included on the following Equipment Rate Schedule. Rates shall not include costs for operators.

LABOR RATE SCHEDULE

	Regular Rate	Overtime Rate
Labor Class	(\$/hr.)	(\$/hr.)
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____
11.	_____	_____
12.	_____	_____
13.	_____	_____
14.	_____	_____
15.	_____	_____

EQUIPMENT RATE SCHEDULE

	Equipment Type	Regular Rate (\$/hr.)	Cost for Mobilization and Demobilization
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
11.	_____	_____	_____
12.	_____	_____	_____
13.	_____	_____	_____
14.	_____	_____	_____
15.	_____	_____	_____

END OF DOCUMENT

Document 004500

CONTRACTOR'S LICENSE FORM

This Document 004500 - Contractor's License Form constitutes an attachment to Document 004113 - Bid Form.

The undersigned, as bidder, declares that our valid California Contractor's license number is

_____ and that the license expiration date is _____ and that the representations made in this Bid are made under penalty of perjury

Signed this _____ day of _____, 20__.

Name of Bidder

Signature of Bidder

Title of Signer

END OF DOCUMENT

Document 005000

**AGREEMENT BETWEEN MONTEREY REGIONAL WASTE
MANAGEMENT DISTRICT AND CONTRACTOR**

THIS Contract made and entered into on _____, 2014 by and between Monterey Regional Waste Management District hereinafter referred to as OWNER and _____, hereinafter referred to as CONTRACTOR. If there is a conflict among any contract documents the provisions of Document 005000 - Agreement Between Monterey Regional Waste Management District and CONTRACTOR shall take precedence.

WITNESSETH

WHEREAS, OWNER desires to employ the services of CONTRACTOR to provide services as described in the Scope of Work.

WHEREAS, CONTRACTOR has provided a bid submittal, to perform the services required to construct the facilities outlined in Exhibit A – Scope of Work.

NOW, THEREFORE, for, in consideration of the promises and other good and valuable considerations, and subject to the terms hereinafter contained, OWNER and CONTRACTOR agree as follows:

1. SCOPE OF WORK

CONTRACTOR shall perform the Work described in Exhibit A in accordance with the Terms and Conditions of this Contract.

2. TIME OF PERFORMANCE

CONTRACTOR shall commence Work immediately upon written notice to proceed by OWNER and shall complete the work All contract work for underground utilities, infrastructure, and etc beneath the proposed asphalt truck parking areas, associated access roads (including the northern-most CNG Fast Fueling access) must be completed by May 1, 2014 after the Notice-to-Proceed is issued by the MRWMD. The truck parking and use of the CNG fueling stations are critical to the MRWMD lease agreement between MRWMD and their Truck Hauling Tenant. All remaining contract work must be completed within two hundred and twenty eight days (228) calendar days after the Notice-to-Proceed is issued by the MRWMD. Should CONTRACTOR fail to achieve substantial completion of the Work within that Contract Time, the CONTRACTOR agrees to pay liquidated damages as stipulated in Supplementary Conditions. Time is of the essence in the performance of CONTRACTOR'S obligations under this Contract.

In accordance with the provisions of §4215 of the California Government Code, the CONTRACTOR shall not be assessed liquidated damages for delay in completion of the project, when such delay was caused by the failure of the public agency or owner of the utility to provide for the removal or relocation of such utility facilities.

3. COMPENSATION AND PAYMENT

- a. Payment. In consideration for materials furnished and services rendered, OWNER shall pay CONTRACTOR in accordance with the provisions specified in Exhibit B. OWNER shall make progress payments to the CONTRACTOR on account of the Contract Price as provided below and elsewhere in the Project Manual. The period covered by each progress payment shall be one calendar month ending on the last day of the month. Each month, not later than the tenth day of the month, CONTRACTOR shall make Application for Payment of work completed during the previous month, as provided in the General Conditions. ENGINEER'S Project Manager will make a recommendation for payment, and OWNER will make a progress payment on the basis of such recommendation, as provided in the document 007000 - General Conditions. Final payment, constituting the entire unpaid balance of the Contract Price, shall be made by OWNER to the CONTRACTOR as provided in the General Conditions. Invoices will be paid within 30 calendar days of receipt of an approved invoice.
- b. Substitution of Securities in Lieu of Retainage. The CONTRACTOR may elect to receive 100 percent of payments due under the Project Manual from time to time, without retention from any portion of the payment by the OWNER, by depositing securities of equivalent value with the OWNER in accordance with the provisions of §22300 of the California Public Contract Code. Such securities, if deposited by the CONTRACTOR, shall be valued by the OWNER, whose decision on valuation of the securities shall be final. Securities eligible for investment under this provision shall be limited to those listed in §22300 of the California Public Contract Code and §16430 of the California Government Code.
- c. Prevailing Wage Rates.
- (1) As required by §§1770 et seq. of the California Labor Code, the CONTRACTOR shall pay not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations. Copies of such prevailing rate per diem wages are on file at the office of the OWNER, which copies shall be made available to any interested party on request. The CONTRACTOR shall post a copy of such determination at each job site.
- (2) As provided in §1775 of the California Labor Code, the CONTRACTOR shall, as a penalty of the OWNER, forfeit \$50.00 for each calendar day, or portion thereof, for each worker paid less than the prevailing rates as determined by the Director for such work or craft in which such worker is employed for any public work or craft in which such worker is employed

for any public work done under the CONTRACTOR by it or by any subcontractor under it.

- d. Retention and Inspection of Payroll Records. As required under the provisions of §1776 of the California Labor Code, each CONTRACTOR and subcontractor shall keep an accurate payroll record, showing the name, address, social security number, work classification, 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 him or her in connection with the public work. The payroll records shall be certified and shall be available for inspection at all reasonable hours at the principal office of the CONTRACTOR under certain specified conditions.
- e. Apprentices. Attention is directed to §§1777.5, 1777.6, and 1777.7 of the California Labor Code and Title 8, California Code of Regulations §§200 et seq. To insure compliance and complete understanding of the law regarding apprentices, and specifically the required ratio thereunder, the CONTRACTOR (and subcontractors) should, where some question exists, contact the Division of Apprenticeship Standards prior to commencement of the work. Responsibility for compliance with this paragraph lies with the CONTRACTOR. The OWNER'S policy is to encourage the employment and training of apprentices on its construction contracts as may be permitted under local apprenticeship standards.
- f. Working Hours. The CONTRACTOR shall comply with all applicable provisions of §§1810 to 1815, inclusive, of the California Labor Code relating to working hours. The CONTRACTOR shall, as a penalty to the OWNER, forfeit \$25.00 for each worker employed in the execution of the Contract by the CONTRACTOR or by any subcontractor for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one (1) calendar day and forty (40) hours in any one (1) calendar week, unless such worker receives compensation for all hours worked in excess of eight (8) hours at no less than 1-1/2 times the basic rate of pay.

4. INTERPRETATION

This Contract, together with the Exhibits attached hereto, and all documents, drawings, specifications and instruments specifically referred to herein and made a part hereof shall constitute the entire Contract between the parties, and no other proposals, conversations, bids, memoranda, or other matter shall vary, alter, or interpret the terms hereof. The captions in this Contract are for the convenience of the parties in identification of the several provisions and shall not constitute a part of this Contract nor be considered interpretative thereof.

Failure of either party to exercise any opinion, right or privilege under this Contract or to demand compliance as to any obligation or covenant of the other party shall not constitute a waiver of any such right, privilege or option, or of the performance thereof, unless waiver is expressly required in such event or is evidenced by a properly executed instrument.

5. INDEPENDENT CONTRACTOR

- a. In accordance with the provisions of California Public Contract Code §3300, the OWNER has determined that the CONTRACTOR possesses a Valid Class A Contractor license at the time that this contract is executed. Failure to possess the specified license shall render this contract void.
- b. CONTRACTOR shall be an independent CONTRACTOR in all its activities hereunder. CONTRACTOR is not to be considered OWNER'S employee for any purpose, including but not limited to the accrual of any employee benefits. CONTRACTOR is not authorized to represent OWNER or otherwise bind OWNER in any dealings between OWNER and any third parties.
- c. All employees furnished by CONTRACTOR to perform the work hereunder shall be deemed to be CONTRACTOR'S employees exclusively and shall be paid by CONTRACTOR for all services in this connection, including but not limited to the accrual of any employee benefits. CONTRACTOR shall be responsible for all obligations and reports covering Social Security, Unemployment Insurance, Workman's Compensation, Income Tax and other reports and deductions required by any applicable State or Federal law.
- d. The work to be performed by CONTRACTOR shall be under the general direction of OWNER'S on-site Resident Construction Representative and shall be limited to the Scope of Work of this Contract. OWNER may direct CONTRACTOR as to what work is to be done, the sequence in which it is to be performed and a schedule indicating start dates and/or completion dates, but shall not be responsible for or direct the means, methods or equipment whereby the work is to be accomplished.

6. SUBCONTRACTS AND ASSIGNMENTS

- a. Subcontractor. CONTRACTOR shall not assign or subcontract any portion of the services required under this Contract without prior written authorization of OWNER.
- b. Assignment of Antitrust Actions in Awarding Body. In accordance with §4551 of the Government Code, the CONTRACTOR and subcontractors shall conform to the following requirements. In entering into a public works contract or subcontract to supply goods, services, or materials pursuant to a public works contract, the CONTRACTOR or subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. §15) or under the Cartwright Act (Chapter 2 commencing with §16700 of Part 2 of Division 7 of the Business and Professions Code).

7. TERMINATION

- a. OWNER, with five days' written notice, may terminate this Contract without cause at any time. Any termination shall become effective in the manner specified in the Notice of Termination and shall be without prejudice to any claim, which OWNER may have against CONTRACTOR or CONTRACTOR may have against OWNER. OWNER shall reimburse CONTRACTOR only for the work performed to date of termination, and for expenses which were reasonably incurred and necessary costs of termination and protection of property.
- b. In the event of a termination for default of CONTRACTOR, CONTRACTOR shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the amount to be paid on this Contract exceeds the cost of finishing the Work, including the cost for additional managerial and administrative services and any other costs and damages OWNER may suffer, that excess amount shall be paid to CONTRACTOR. If the expense, compensation, costs, and damages exceed any unpaid balance, CONTRACTOR and its sureties, if any, shall be liable for and shall pay the difference to OWNER.
- c. Notwithstanding the above, the total amount due CONTRACTOR upon termination will not exceed the total compensation stated in Exhibit B.

8. FORCE MAJEURE

CONTRACTOR shall not be liable for failure or delay in delivery of services or delivery of goods due to Acts of God; war; civil commotion; labor disputes or strikes (including labor disputes and strikes involving employees of CONTRACTOR); fire, flood, or other casualty; governmental actions, priorities, or regulations; supplier or CONTRACTOR

delay; or any cause beyond CONTRACTOR'S reasonable control whether of similar or dissimilar nature than those enumerated. CONTRACTOR shall have such additional time within which to perform the Work as may be reasonably determined as the result of any of the above causes.

9. INDEMNIFICATION

CONTRACTOR shall indemnify, defend, and hold OWNER harmless from and against claims, liabilities, suits, loss, cost, and expense and damages arising from or in connection with CONTRACTOR'S performance of work pursuant to this Contract.

10. WARRANTIES

- a. CONTRACTOR warrants that all Work shall strictly comply with the provisions of this Contract and all specifications and drawings referred to in this Contract or thereafter furnished by OWNER and shall be free from defects in construction and workmanship and in any design or engineering furnished by CONTRACTOR. CONTRACTOR further warrants that all materials, equipment, and supplies furnished by CONTRACTOR for the Work shall be new, merchantable, of the most suitable grade, and fit for their intended purposes. Without limitation of any other rights or remedies of OWNER, if any defect in the Work in violation of the foregoing warranty appears within the period set forth below, CONTRACTOR shall upon receipt of written notice of such defect, promptly furnish, at no cost to OWNER, all labor, equipment and materials at the job site necessary to correct such defects and cause the Work to comply fully with the foregoing warranties.
- b. CONTRACTOR'S warranties set forth in "10.a." above shall extend for a period of 12 months after the date of final written acceptance of the Work by OWNER.
- c. All labor, equipment, and materials furnished by CONTRACTOR pursuant to "10.a." above to correct defects shall be warranted by CONTRACTOR in accordance with the warranties set forth in "10.a." above for a period of 12 months from the date of acceptance by OWNER of such corrections.
- d. If CONTRACTOR is notified of any defects in the Work and fails to promptly cure such defects, OWNER shall have the right to cure or to have such defects cured at CONTRACTOR'S cost and expense, and CONTRACTOR shall promptly reimburse OWNER for such costs and expenses.

11. INSURANCE

a. Workers' Compensation

- (1) In accordance with provisions of §1860 of the California Labor Code, the CONTRACTOR'S attention is directed to the requirement that, in accordance with the provisions of §3700 of the California Labor Code, every contractor will be required to secure the payment of compensation of his or her employees.
- (2) In accordance with the provisions of §1861 of the California Labor Code, each contractor to whom a public works contract is awarded shall sign and file with the awarding body the following certification prior to performing the work of the contract: "I am aware of the provisions of §3700 of the Labor Code which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract."

b. Without limiting its liability to OWNER, CONTRACTOR shall place and maintain with responsible insurance carriers the following insurance. Prior to commencing work under this Contract, CONTRACTOR shall deliver to OWNER certificates of insurance evidencing coverage in accordance with this Article and an obligation to which shall provide thirty calendar days notice to OWNER in the event of a material change in coverage or cancellation. As to the insurance set out in Paragraphs (2) and (3) below, CONTRACTOR shall have OWNER named as additional insured and CONTRACTOR shall provide a certificate of insurance to OWNER before work is started.

- (1) Worker's Compensation and Employer's Liability Insurance. Workers' Compensation in compliance with the applicable State and Federal laws.

Employer Liability Limit \$1,000,000.

- (2) Comprehensive General Liability Insurance including Blanket Contractual; Excavation, Collapse and Underground (XCU) Hazards; Broad Form Property Damage; Completed Operations and Independent Contractor's Liability all applicable to Personal Injury, Bodily Injury and Property Damage to a combined single limit of \$1,000,000 each occurrence subject to \$2,000,000 annual aggregate for Completed Operations and Personal Injury other than Bodily Injury and Products/Completed Operations shall

apply separately with respect to each project away from CONTRACTOR'S owned or rented premises.

- (3) Comprehensive Automobile Liability Insurance including owned, hired and non-owned automobiles, Bodily Injury and Property Damage to a combined single limit of \$1,000,000 each occurrence.

12. UNEMPLOYMENT INSURANCE AND TAXES

CONTRACTOR shall have full and exclusive liability for the payment of any and all taxes and contributions for unemployment insurance, old age retirement benefits and similar pensions, and annuities which may now or hereafter be imposed by the United States, any state, or any local governmental authority, whether measured by the wages, salaries, or remuneration paid to persons employed by CONTRACTOR or otherwise, for the Work. CONTRACTOR shall comply with all Federal and State laws on such subjects, including all rules and regulations and shall maintain suitable forms, books and records, and save OWNER free and harmless from, and hereby indemnifies OWNER and against, liability for the payment of any and all such taxes, excises, assessments, or other charges levied by any governmental authority on or because of the Work, including, without limitation, the use of any equipment, supplies or materials pursuant to this Contract.

13. DISCLOSURE OF INFORMATION

No news release, including photographs and films, public announcement, denial or confirmation shall be made by CONTRACTOR concerning subject matter of this Contract, or any phase of any program hereunder, without the prior written approval of OWNER.

14. SEVERABILITY

It is understood and agreed by the parties hereto that if any part, term, or provision of this Contract is held illegal or in conflict with any law of the State where made or having jurisdiction over any of the parties hereto, the validity of the remaining portions or provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular part, term, or provisions held to be invalid.

15. CHANGES

- a. Preference for Materials. Notwithstanding any other provision of the Bid Documents or Specifications to the contrary, any reference in the Project Manual to any material, item of equipment or type of construction by manufacturer's name, make, catalogue number, service or other proprietary identification shall be interpreted as establishing a standard of quality and shall not be construed as

limiting competition. Bidders may furnish any equal material, product, or service if the OWNER so approves.

If the CONTRACTOR wishes to propose a substitute or equal item for any specified by brand or trade name, he shall in writing notify the OWNER of his intent to do so and at this time submit to the OWNER an itemized list of the item or items he proposes setting forth the various manufacturers, names and such other information he has available. Unless this notification is given, the CONTRACTOR shall provide only the items specified by brand or trade name. If notification is so given the OWNER, within thirty-five (35) calendar days after issuance of Notice of Award, the CONTRACTOR shall supply data to the OWNER to substantiate the proposed substitution or equal. The OWNER will then decide whether the proposed substitution or equal is in fact equal in quality and utility to the specified trade or brand name items. It is agreed that the decision of the OWNER in this matter shall be final and that if the OWNER determines that the proposed substitution is not equal to that specified, the CONTRACTOR shall provide equipment which meets the specifications at the price specified in the CONTRACTOR'S Bid.

- b. Changes. OWNER, without invalidating this Contract, may direct changes within the general scope of work required by this Contract by altering, adding to and/or deducting from the work to be performed. If any changes under this clause, whether directed or otherwise, cause an increase or decrease in CONTRACTOR'S cost of, or the time required for, the performance of the work under this Contract, CONTRACTOR shall notify OWNER within five working days of the date of occurrence of any such change. CONTRACTOR shall submit detailed justification of time and cost impacts for review and approval of Contract. After mutual agreement has been reached by the parties, an equitable adjustment will be made to the contract time or price, and the Contract will be modified in writing accordingly. All such changes in the work shall be in writing and shall be performed subject to the provisions of this CONTRACTOR.

16. INSPECTION AND ACCEPTANCE

- a. All equipment and materials furnished to OWNER, and workmanship performed by CONTRACTOR or its lower-tier subcontractors shall be subject to final inspection, tests, and acceptance by OWNER or its representatives upon completion of all Work. OWNER may also inspect and reject any materials, equipment, or workmanship at any time during the performance of the Work. OWNER'S inspections shall not relieve CONTRACTOR from its obligation to comply with the requirements of this Contract. OWNER reserves the right to charge to CONTRACTOR any additional cost of inspection or test when material or workmanship is not ready at the time specified by the CONTRACTOR for

inspection or test, or when reinspection or retesting is necessitated by prior rejection. The failure of OWNER to inspect or test, or to discover defective material or workmanship, shall not prejudice the rights of OWNER upon the final inspection.

- b. CONTRACTOR, at its expense, shall promptly correct any workmanship which does not comply with the requirements of this Contract, and shall promptly repair or replace any material or equipment (except material or equipment furnished by OWNER) which is defective or does not conform to the Contract requirements, prior to resubmitting the Work for acceptance. If CONTRACTOR fails to repair or replace rejected equipment or material, or correct rejected workmanship promptly, OWNER, at its option, may repair, replace or correct the defective workmanship, equipment or material, and all costs and expenses of OWNER in correcting the defective Work shall be the responsibility of CONTRACTOR and shall be paid to OWNER on demand. Instead of requiring correction, removal, or replacement of defective Work, OWNER may accept the Work in its defective or unapproved state and a Subcontract amendment shall be issued to incorporate any unnecessary revisions to the Subcontract documents, including an appropriate reduction to the Contract price.
- c. CONTRACTOR acknowledges that the OWNER or its representatives may also inspect any materials, equipment, or workmanship at any time during the performance of the Work.

17. SUSPENSION OF WORK

- a. OWNER may, at any time, suspend performance of all or any part of the Work by giving not less than five working days written notice to CONTRACTOR. The suspension may be continued by OWNER for a period up to sixty calendar days during which period OWNER may at any time, by written notice, require CONTRACTOR to resume performance of the Work. If at the end of the sixty-day period of suspension OWNER has not required a resumption of Work, that portion of the Work which has been suspended may be terminated by either party pursuant of the provisions of this paragraph. CONTRACTOR shall be compensated in accordance with, and shall follow the procedures specified in, paragraph 15 above.
- b. OWNER shall not be liable for any damages, anticipated profits, or costs incurred with respect to suspended Work during any period of suspension, except for costs which (i) are incurred for the purpose of safeguarding the Work, materials, and equipment in transit or at the job site, (ii) are incurred for such CONTRACTOR personnel or rented equipment which are maintained at the job

site, or (iii) are other reasonable and unavoidable costs of shutting down the Work or reassembling personnel and equipment.

18. PROTECTION OF WORKERS IN TRENCH EXCAVATIONS

As required by §6705 of the California Labor Code and in addition thereto, whenever work under the Contract involves the excavation of any trench or trenches five (5) feet or more in depth, the CONTRACTOR shall submit for acceptance by the OWNER or by a registered civil or structural ENGINEER, employed by the OWNER, to whom authority to accept has been delegated, in advance of excavation, a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation, of such trench or trenches. If such plan varies from the shoring system standards established by the Construction Safety Orders of the Division of Industrial Safety, the plan shall be prepared by a registered civil or structural ENGINEER employed by the CONTRACTOR, and all costs therefor shall be included in the price named in the Contract for completion of the Work as set forth in the Project Manual. Nothing in this Section shall be deemed to allow the use of a shoring, sloping, or other protective system less effective than that required by the Construction Safety Orders. Nothing in this Section shall be construed to impose tort liability on the OWNER, the ENGINEER, nor any of their officers, agents, representatives, or employees.

19. NOTICE OF THIRD PARTY CLAIMS AGAINST THE CONTRACTOR

The CONTRACTOR shall give the OWNER immediate notice of any suit or action filed, or any claims made, against the CONTRACTOR arising out of the performance of this Contract or any lower-tier subcontracts. The CONTRACTOR shall furnish immediately to the OWNER copies of all documents received by the CONTRACTOR pertinent to such actions, suit or claim.

20. BENEFICIAL OCCUPANCY AND POSSESSION PRIOR TO COMPLETION

The OWNER shall have the right to take possession of or use any completed or partially completed part of the CONTRACTOR'S Work as OWNER may deem necessary for their operations upon notice to the CONTRACTOR. During such occupancy, OWNER shall exercise all reasonable efforts to avoid interference with the CONTRACTOR'S continuance of the Work. Such occupancy shall not constitute acceptance of the CONTRACTOR'S Work and the CONTRACTOR will remain responsible for that portion of the Work so occupied until final acceptance under the terms of this Contract and thereafter pursuant to the guarantees and warranty provisions of this Contract; provided that CONTRACTOR shall not be responsible for any damage or loss caused by OWNER.

21. CONTRACTOR'S FINAL RELEASE CERTIFICATE AND INDEMNIFICATION

Upon completion and acceptance of all Work, the CONTRACTOR shall complete the "Contractor's Final Release Certificate or Indemnity" hereto referred as Exhibit C attached hereto and incorporated into this Contract by reference. This Certificate shall be submitted to OWNER along with the CONTRACTOR'S final invoice as prescribed in the Compensation and Payment section of this Contract.

22. INDEX OF ATTACHMENTS

The following list of Exhibits are incorporated herein and made a part thereof:

Exhibit A – Scope of Work

Exhibit B – Payment Schedule

Exhibit C – Contractor’s Final Release Certificate and Indemnity

Exhibit D - List of Documents

Addendum No. _____

MONTEREY REGIONAL WASTE

MANAGEMENT DISTRICT

(CONTRACTOR)

(OWNER)

(Signature)

(Signature)

(Print Name and Title) William M. Merry

Date

Date

()
(Corporate)
(Seal)
()

()
(MRWMD)
(Seal)
()

EXHIBIT A

SCOPE OF WORK

The CONTRACTOR will provide, furnish and install the material, equipment and labor necessary to accomplish the work as defined in Bid Documents.

END OF EXHIBIT

EXHIBIT B

CONTRACTOR'S FINAL RELEASE CERTIFICATE AND INDEMNITY

This Release and Certificate is made in accordance with the provisions of Contract No. _____ including any and all Amendments thereto, executed by _____ hereinafter referred to as the "CONTRACTOR" and Monterey Regional Waste Management District hereinafter referred to as the "OWNER."

In consideration of payments heretofore, or to be made by the OWNER to the CONTRACTOR for labor, materials, and services furnished by the CONTRACTOR in the performance of said Contract, the CONTRACTOR hereby unconditionally releases the OWNER, their Officers, Agents, Employees, Assigns, or Heirs from any and all liens and claims whatsoever arising out of or during the performance of said Contract, other than such claims, if any, that may with the consent of the OWNER be specifically excepted from the terms of this Release and Certificate, stated on Sheet 1, attached hereto (or, if none, so state): _____ and in further consideration of the aforesaid payments CONTRACTOR being first duly sworn, further affirms and certifies under penalty of perjury that all labor, and services of every nature by whomsoever furnished in connection with the performance of said CONTRACT and all applicable State and Federal payroll taxes and payroll insurance have been paid and CONTRACTOR hereby agrees to indemnify OWNER, against, and hold them harmless of and from, all liens, claims, demands, penalties, losses, costs, damages, and liability in any manner whatsoever heretofore or hereafter arising out of or in respect of any claim by any person or governmental agency for payment for work, labor, services, or materials performed, furnished, or rendered under or pursuant to or in respect of the performance of said CONTRACTOR.

Executed this _____ day of _____ 20 ____.

CONTRACTOR

By _____

OFFICIAL TITLE

(If the CONTRACTOR is a corporation, the following Certificate will be executed.)

I, _____, certify that I am _____ of the Corporation executing this Release and Certificate; that _____ who signed this Release and Certificate on behalf of the CONTRACTOR was then _____ of said Corporation; that said Release and Certificate was duly signed for and on behalf of said Corporation by authority of its governing body, and is within the scope of its corporate powers.

STATE OF _____)

COUNTY OF _____)

Subscribed and sworn to before me this _____ day of _____, 20__.

NOTARY PUBLIC FOR SAID STATE

END OF EXHIBIT

EXHIBIT C

LIST OF DOCUMENTS

<u>Document #</u>	<u>Name</u>
004113	Bid Form
004400	Labor and Equipment Rates Schedules
005000	Notice of Award
006100	Performance Bond
006150	Certificates of Insurance
006200	Payment Bond
006500	Notice to Proceed
007000	Standard General Conditions of the Construction Contract
008000	Supplementary Conditions
	General Requirements and Site Work - Divisions 1 & 2
	Construction Drawings (reduced)
	CQA Plan

END OF EXHIBIT

Document 005100

NOTICE OF AWARD

To: _____

PROJECT DESCRIPTION: Monterey Peninsula Landfill, Truck Yard Project construction located approximately two miles north of the City of Marina, at 14207 Del Monte Blvd, Marina, CA 93933, Monterey County, California, in accordance with Contract Specifications, Contract Drawings, and Contract Documents.

The OWNER has considered the proposal submitted by you for the above-described work.

You are hereby notified that your proposal has been accepted for items in the amount of \$_____.

The agreement must be executed and the Contractor's Performance Bond, Payment Bond, and certificates of insurance must be furnished within ten (10) calendar days from the date of this notice.

If you fail to execute said agreement and to furnish said bonds within ten (10) days from the date of this notice, the OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your proposal as abandoned and as a forfeiture of your Bid Bond. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the OWNER.

Dated this _____ day of _____, 20_____.

William M. Merry, General Manager

Monterey Regional Waste Management District

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by

this the _____ day of _____, 20____.

END OF DOCUMENT

Document 006100

PERFORMANCE BOND

THE STATE OF _____ §

§ KNOW ALL MEN BY THESE PRESENTS:

THE COUNTY OF _____ §

THAT WE, _____

_____, as Principal, hereinafter called "CONTRACTOR", and the other subscriber hereto as Surety, do hereby acknowledge ourselves to be held and firmly bound to OWNER in the sum of _____ Dollars (\$ _____)

for the payment of which sum, well and truly to be made to the OWNER and its successors, the said CONTRACTOR and Surety do bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the CONTRACTOR has on or about this day executed a Contract in writing with the OWNER for

Monterey Peninsula Landfill – Truck Yard Project

all of such work to be done as set out in full in said Project Manual therein referred to and adopted by the OWNER all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said CONTRACTOR shall faithfully and strictly perform Contract in all its terms, provisions, and stipulations in accordance with its true meaning and effect, and in accordance with the Project Manual referred to therein and shall comply strictly with each and every provision of Contract and with this bond, then this obligation shall become null and void and shall have no further force and effect; otherwise the same is to remain in full force and effect.

It is further understood and agreed that the Surety does hereby relieve the OWNER or its representatives from the exercise of any diligence whatever in securing compliance on the part of the CONTRACTOR with the terms of the Contract, and the Surety hereby waives any notice to it of any default, or delay by the CONTRACTOR in the performance of his Contract and agrees that it, the Surety, shall be bound to take notice of and shall be held to have knowledge of all

acts or omissions of the CONTRACTOR in all matters pertaining to the contract. The Surety understands and agrees that the provision in the Contract that the OWNER shall retain certain amounts due the CONTRACTOR until the expiration of thirty calendar days from the acceptance of the Work is intended for the OWNER'S benefit, and the OWNER shall have the right to pay or withhold such retained amounts or any other amount owing under the Contract without changing or affecting the liability of the Surety hereon in any degree.

It is further expressly agreed by Surety that the OWNER or its representatives are at liberty at any time, without notice to the Surety, to make any change in the Project Manual and in the Work to be done thereunder, as provided in the Contract, and in the terms and conditions thereof, or to make any change in, addition to, or deduction from the work to be done thereunder; and that such changes, if made, shall not in any way vitiate the obligation in this bond and undertaking or release the Surety therefrom.

It is further expressly agreed and understood that the CONTRACTOR and Surety will fully indemnify and save harmless the OWNER from any liability, loss, cost, expense, or damage arising out of or in connection with the work done by the CONTRACTOR under the Contract. In the event that the OWNER shall bring any suit or other proceeding at law on the Contract or this bond or both, the CONTRACTOR and Surety agree to pay to the OWNER the sum of 10 percent of whatever amount may be recovered by the OWNER in suit or legal proceeding, which sum of 10 percent is agreed by all parties to be indemnity to the OWNER for the expense of or time consumed by its Attorney, his assistants, and office force, and other cost and damage occasioned to the OWNER. This amount of 10 percent is fixed and liquidated by the parties, it being agreed by them that the exact damage to the OWNER would be difficult to ascertain.

This bond and all obligations created hereunder shall be performable in Monterey County, in the State of California. When this bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

IN WITNESS THEREOF, the Said Principal and Surety have signed and sealed this instrument on the respective dates written below their signature.

CONTRACTOR AS PRINCIPAL

SURETY

Company Name

Surety Name

By _____
Name:
Title:
Date:

By _____
Name:
Title:
Date:

Attest/Witness or Corporate Seal

Attest/Witness or Corporate Seal

By _____
Name:
Title:
Date:

By _____
Name:
Title:
Date:

THE FOREGOING BOND IS ACCEPTED ON
BEHALF OF MONTEREY REGIONAL WASTE MANAGEMENT DISTRICT

Name: William M. Merry
Title: General Manager
Date:

END OF DOCUMENT

Document 006200

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____

as Principal, hereinafter called CONTRACTOR, and, _____

as Surety, hereinafter called Surety, are held and firmly bound unto:

Monterey Regional Waste Management District
14201 Del Monte Boulevard
P.O. Box 1670

Marina, California 93933-1670

As Obligee, hereinafter called OWNER, for the use and benefit of claimants as herein below defined, in the penal sum of _____ Dollars (\$ _____), lawful money of the United States, for the payment whereof well and truly to be made, CONTRACTOR and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

CONTRACTOR has by written agreement dated _____, 20____, entered into a contract with the District for all construction required to complete the Contract for Truck Yard Project Construction for the Monterey Peninsula Landfill, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if CONTRACTOR shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, and any and all duly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, then this obligation shall be void; otherwise it shall remain in full force and effect, subject to the following conditions:

- 1) A claimant is defined as one having furnished labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental of equipment directly applicable to the Contract.

- 2) The above named CONTRACTOR and Surety hereby jointly and severally agree with the OWNER that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety calendar days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this Bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, including attorney fees and interest, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.
- 3) No suit or action shall be commenced hereunder by any claimant:
 - a) Unless claimant, other than one having a direct contract with the CONTRACTOR, shall have given written notice to any two of the following: the CONTRACTOR, the OWNER, or the Surety above named, within ninety calendar days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the CONTRACTOR, OWNER, or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.
 - b) After the expiration of one year following the date on which CONTRACTOR ceased Work on said Contract, it being understood, however, that if any limitation embodied in this Bond is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.
 - c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the Project, or any part thereof, is situated, or in the United States District Court for the district in which the Project, or any part thereof, is situated, and not elsewhere.
- 4) The amount of this bond shall be reduced by and to the extent of any payments promptly made by Surety in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said

improvement, whether or not claim for the amount of such lien be presented under and against this bond.

- 5) The terms and conditions of this bond shall be deemed to be amended so as to comply with any statutory requirements for labor and material payment bonds, in the event the law controlling the construction of this bond shall prohibit such terms and conditions or shall prescribe different or additional terms and conditions.

Signed this _____ day of _____, 20_____.

Witness: _____ Principal: _____

()
()
(Corporate)
(Seal)
()
()

By: _____

Title: _____

Legal Address: _____

Attest: _____
(Corporate Secretary)

Witness: _____ Surety : _____

()
()
(Corporate)
(Seal)
()
()

By: _____

Title: _____

Legal Address: _____

Attest: _____
(Corporate Secretary)

END OF DOCUMENT

Document 006500

NOTICE TO PROCEED

Date: _____

To: _____

Address: _____

Project Title: Truck Yard Project

Site Name: Monterey Peninsula Landfill for Monterey Regional Waste Management District

Location: 14207 Del Monte Blvd, Marina California, 93933

You are hereby notified that the Date of Commencement of the Work is _____. On that date you are to start performing your obligations under the Project Manual. In accordance with Article 2 of the Agreement, the date on which penalties for delay shall commence is established as 228 calendar days from the date of this notice to proceed.

A pre-construction conference will be held at 1:00 PM on November 3, 2014 at the Monterey Regional Waste Management District.

Additionally before you may start any Work at the site, you must:

N/A

MONTEREY REGIONAL WASTE MANAGEMENT DISTRICT

BY: _____

Richard D. Shedden, P.E., Project Manager

cc: _____

END OF DOCUMENT

APPLICATION AND RECOMMENDATION FOR PAYMENT

APPLICATION NO. _____	FOR PERIOD BEGINNING _____ & ENDING _____
CONTRACTOR'S APPLICATION FOR PAYMENT	
A. Total Work Completed to Date 1. For Lump Sum Work, attach percentage complete of each portion of the Work listed in the Schedule of Values.	\$
B. Materials Currently Stored and Not Incorporated Into the Work = _____, X .85 =	\$
C. Total Earnings To Date (A + B)	\$
D. Retainage, as a percentage of Total Work Completed to Date (check one): ____ 10% for Progress Payment ____ 0% for Final Payment ____ Other: _____	\$
E. Liquidated Damages: _____ Days at \$_____/Day	\$
F. Total Reductions (D + E)	\$
G. Total Payments Due To Date (C - F)	\$
H. Previous Recommendations for Payment	\$
I. TOTAL AMOUNT DUE CONTRACTOR THIS DATE:	\$

CONTRACT AMOUNT SUMMARY		CONTRACT TIME SUMMARY	
A. ORIGINAL CONTRACT PRICE	\$	ORIGINAL CONTRACT TIME	
B. Approved Change Orders:		C. Approved Change Order Extensions:	
# _____	\$ _____	# _____, _____	
# _____	\$ _____	days	
# _____	\$ _____	# _____, _____	
# _____	\$ _____	days	
# _____	\$ _____	# _____, _____	
# _____	\$ _____	days	
	\$	# _____, _____	
		days	
C. TOTAL CURRENT CONTRACT PRICE	\$	C. TOTAL CURRENT CONTRACT TIME	
D. TOTAL EARNINGS TO DATE	\$	D. DAYS USED TO DATE	
E. PERCENTAGE EARNINGS TO DATE	\$	E. PERCENTAGE DAYS USED TO DATE	
CURRENT CONTRACT SUBSTANTIAL COMPLETION DATE: _____			
CONTRACTOR'S Estimated Substantial Completion Date: ____/____/____			
(Attach monthly revised construction schedule in accordance with Paragraph 3.11.3 of General Conditions)			

CONTRACTOR'S CERTIFICATION

CONTRACTOR hereby certifies that (1) all previous payments received from the OWNER for Work completed under this Contract have been applied by CONTRACTOR to discharge in full all obligations of CONTRACTOR incurred in connection with the Work covered by all previous Applications For Payment, and (2) all materials and equipment incorporated in the completed Work covered by the Application For Payment are free and clear of all liens, claims, security interests, and encumbrances.

_____ By: _____
 (Contractor)

(Name)

(Title)

(Date)

RECOMMENDATION FOR PAYMENT

Having reviewed the CONTRACTOR'S Application for Payment and supporting information, (initial appropriate action)

_____ I recommend payment for the full amount of the application, that is, \$_____.

_____ I recommend payment for a portion of the amount of the application, in the amount of \$_____. Payment for the remaining \$_____ of the application is contingent on receipt of the corrections or additional information marked on the application.

_____ I am returning the Application for Payment to the CONTRACTOR for the corrections or additional information marked on the application.

_____ I decline to recommend payment on the basis of the provisions in Paragraph 9.6 of the General Conditions and described more specifically in Attachment A.

By: _____
Richard D. Shedden, P.E., Project Manager

Date: _____

END OF DOCUMENT

Document 006750

CHANGE ORDER

To: _____

From: _____

Re: _____

PART 1 - NATURE OF CHANGES

1.01 Brief description of changes in the Work:

1.02 Reason for changes:

1.03 Changes are described in detail in the following attachments, which are hereby made a part of this Change Order:

PART 2 - ADJUSTMENTS TO CONTRACT

2.01 Change to Contract Price

Amounts,	Percentage of Original	Dollar
	<u>Contract Price</u>	<u>Contract Price</u>
A. Original Contract Price	<u>100%</u>	_____
B. Previous Change Orders	_____	_____
C. This Change Order	_____	_____
D. New Total Contract Price	_____	_____

2.01 Change to Contract Time

	Percentage of Original	
	<u>Contract Time</u>	<u>Date or Days</u>
A. Contract Commencement Date		_____
B. Original Contract Time	<u>100%</u>	_____ days
C. Previous Change Order Extensions	_____	_____ days
D. This Change Order Extension	_____	_____ days
E. New Total Contract Time	_____	_____ days
F. New Substantial Completion Date		_____

PART 3 - CONTRACTOR'S ACCEPTANCE

The undersigned Contractor agrees to perform the changes stipulated in this Change Order and any attachments for the dollar amount indicated and within the contract time indicated.

(Contractor)

By _____
(Signature)

(Printed Typed Name)

(Title)

(Date)

PART 4 - MONTEREY REGIONAL WASTE MANAGEMENT DISTRICT'S APPROVAL

By _____

(Signature)

Richard D. Shedden, P.E. _____

(Typed Name)

Project Manager _____

(Title)

(Date)

END OF DOCUMENT

DOCUMENT 00700

Standard General Conditions of the Construction Contract

This document has important legal consequences: consultation with an attorney is encouraged with respect to its completion or modification.

**STANDARD
GENERAL CONDITIONS
OF THE
CONSTRUCTION CONTRACT**

Prepared by

Engineers Joint Contract Documents Committee

and

Issued and Published Jointly By



PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN CONSULTING ENGINEERS COUNCIL

AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSTRUCTION SPECIFICATIONS INSTITUTE

This document has been approved and endorsed by

The Associated General  Contractors of America

These General Conditions have been prepared for use with the Owner-Contractor Agreements (No. 1910-A-1 or 1910-8-A-2) (1990 Editions). Their provisions are interrelated and a change in one may necessitate a change in the others. Comments concerning their usage are contained in the Commentary on Agreements for Engineering Services and Contract Documents (No. 1910-9) (1986 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. 1910-17) (1990 Edition). When bidding is involved, the Standard Form of Instructions to Bidders (No. 1910-12) (1990 Edition) may be used.

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GENERAL CONDITIONS

ARTICLE I—DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the Contract Documents.

1.2. *Agreement*—The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.3. *Application for Payment*—The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

1.5. *Bid*—The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6. *Bidding Documents*—The advertisement or invitation to Bid, instructions to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

1.7. *Bidding Requirements*—The advertisement or invitation to Bid, instructions to bidders, and the Bid form.

1.8. *Bonds*—Performance and Payment bonds and other instruments of security.

1.9. *Change Order*—A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

1.10. *Contract Documents*—The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agree-

ment, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER's written interpretations and clarifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1.1 and 4.2.2.2 are not Contract Documents.

1.11. *Contract Price*—The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

1.12. *Contract Times*—The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13.

1.13. *CONTRACTOR*—The person, firm or corporation with whom OWNER has entered into the Agreement.

1.14. *defective*—An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

1.15. *Drawings*—The drawings which show the scope, extent and character of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents. Shop drawings are not Drawings as so defined.

1.16. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

1.17. *ENGINEER*—The person, firm or corporation named as such in the Agreement.

1.18. *ENGINEER's Consultant*—A person, firm or corporation having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

1.19. *Field Order*—A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.

1.20. *General Requirements*—Sections of Division 1 of the Specifications.

1.21. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

1.22. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

1.23. *Liens*—Liens, charges, security interests or encumbrances upon real property or personal property.

1.24. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

1.25. *Notice of Award*—The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

1.26. *Notice to Proceed*—A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

1.27. *OWNER*—The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

1.28. *Partial Utilization*—Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

1.29. *PCBs*—Polychlorinated biphenyls.

1.30. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.

1.31. *Project*—The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

1.32. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

1.33. *Resident Project Representative*—The authorized representative of ENGINEER who may be assigned to the site or any part thereof.

1.34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

1.35. *Shop Drawings*—All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

1.36. *Specifications*—Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.37. *Subcontractor*—An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.38. *Substantial Completion*—The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.39. *Supplementary Conditions*—The part of the Contract Documents which amends or supplements these General Conditions.

1.40. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.41. *Underground Facilities*—All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

1.42. *Unit Price Work*—Work to be paid for on the basis of unit prices.

1.43. *Work*—The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

1.44. *Work Change Directive*—A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in paragraph 10.2.

1.45. *Written Amendment*—A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

ARTICLE 2—PRELIMINARY MATTERS

Delivery of Bonds:

2.1. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2. OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Times; Notice to Proceed:

2.3. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will the

Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

Starting the Work:

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

Before Starting Construction:

2.5. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents, unless CONTRACTOR knew or reasonably should have known thereof.

2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2.6.2. a preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;

2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.7. Before any Work at the site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with paragraphs 5.4, 5.6 and 5.7.

Preconstruction Conference:

2.8. Within twenty days after the Contract Times start to run, but before any Work at the site is started, a conference

attended by CONTRACTOR, ENGINEER and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.6, procedures for handling Shop Drawings and other submittals, processing Applications for Payment and maintaining required records.

Initially Acceptable Schedules:

2.9. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.6. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until the schedules are submitted to and acceptable to ENGINEER as provided below. The progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified Milestones and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor. CONTRACTOR's schedule of Shop Drawing and Sample submissions will be acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the required submittals. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance.

**ARTICLE 3—CONTRACT DOCUMENTS: INTENT,
AMENDING, REUSE**

Intent:

3.1. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases which have a well-known technical or construction industry or trade meaning are used to describe Work, materials or equipment, such words or phrases shall be interpreted in accordance with that meaning. Clarifi-

cations and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3. Reference to Standards and Specifications of Technical Societies; Reporting and Resolving Discrepancies:

3.3.1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

3.3.2. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier referred to in paragraph 6.5, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.5 or 3.6; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

3.3.3. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and:

3.3.3.1. the provisions of any such standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

3.3.3.2. the provisions of any such Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

No provision of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's Consultants, agents or employees any duty or authority to supervise or direct the furnishing or

performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents.

Amending and Supplementing Contract Documents:

3.5. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

- 3.5.1. a formal Written Amendment,
- 3.5.2. a Change Order (pursuant to paragraph 10.4), or
- 3.5.3. a Work Change Directive (pursuant to paragraph 10.1).

3.6. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

- 3.6.1. a Field Order (pursuant to paragraph 9.5),
- 3.6.2. ENGINEER's approval of a Shop Drawing or Sample (pursuant to paragraphs 6.26 and 6.27), or
- 3.6.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.7. CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not have or acquire any title to or ownership rights in any

of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

ARTICLE 4—AVAILABILITY OF LANDS;
SUBSURFACE AND PHYSICAL
CONDITIONS; REFERENCE POINTS

Availability of Lands:

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2. Subsurface and Physical Conditions:

4.2.1. *Reports and Drawings:* Reference is made to the Supplementary Conditions for identification of:

4.2.1.1. *Subsurface Conditions:* Those reports of explorations and tests of subsurface conditions at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents; and

4.2.1.2. *Physical Conditions:* Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by ENGINEER in preparing the Contract Documents.

performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents.

Amending and Supplementing Contract Documents:

3.5. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.5.1. a formal Written Amendment.

3.5.2. a Change Order (pursuant to paragraph 10.4), or

3.5.3. a Work Change Directive (pursuant to paragraph 10.1).

3.6. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.6.1. a Field Order (pursuant to paragraph 9.5),

3.6.2. ENGINEER's approval of a Shop Drawing or Sample (pursuant to paragraphs 6.26 and 6.27), or

3.6.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.7. CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not have or acquire any title to or ownership rights in any

of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

**ARTICLE 4—AVAILABILITY OF LANDS;
SUBSURFACE AND PHYSICAL
CONDITIONS; REFERENCE POINTS**

Availability of Lands:

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2. Subsurface and Physical Conditions:

4.2.1. *Reports and Drawings:* Reference is made to the Supplementary Conditions for identification of:

4.2.1.1. *Subsurface Conditions:* Those reports of explorations and tests of subsurface conditions at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents; and

4.2.1.2. *Physical Conditions:* Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by ENGINEER in preparing the Contract Documents.

4.2.2. *Limited Reliance by CONTRACTOR Authorized; Technical Data:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

4.2.2.1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto, or

4.2.2.2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or

4.2.2.3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

4.2.3. *Notice of Differing Subsurface or Physical Conditions:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the site that is uncovered or revealed either:

4.2.3.1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, or

4.2.3.2. is of such a nature as to require a change in the Contract Documents, or

4.2.3.3. differs materially from that shown or indicated in the Contract Documents, or

4.2.3.4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then

CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.23), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such conditions or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

4.2.4. *ENGINEER's Review:* ENGINEER will promptly review the pertinent conditions, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5. *Possible Contract Documents Change:* If ENGINEER concludes that a change in the Contract Documents is required as a result of a condition that meets one or more of the categories in paragraph 4.2.3., a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6. *Possible Price and Times Adjustments:* An equitable adjustment in the Contract Price or in the Contract Times, or both, will be allowed to the extent that the existence of such uncovered or revealed condition causes an increase or decrease in CONTRACTOR's cost of, or time required for performance of, the Work; subject, however, to the following:

4.2.6.1. such condition must meet any one or more of the categories described in paragraphs 4.2.3.1 through 4.2.3.4, inclusive;

4.2.6.2. a change in the Contract Documents pursuant to paragraph 4.2.5 will not be an automatic authorization of nor a condition precedent to entitlement to any such adjustment;

4.2.6.3. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of paragraphs 9.10 and 11.9; and

4.2.6.4. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Times if;

4.2.6.4.1. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a bid or becoming bound under a negotiated contract; or

4.2.6.4.2. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test or study of the site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

4.2.6.4.3. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.2.3.

If OWNER and CONTRACTOR are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.3. *Physical Conditions—Underground Facilities:*

4.3.1. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on

information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2. The cost of all of the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2. *Not Shown or Indicated:* If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.23), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence of the Underground Facility. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or the amount or length of any such adjustment in Contract Price or Contract Times, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages incurred or sustained by CONTRACTOR on or in connection with any other project or anticipated project.

Reference Points:

4.4. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations

without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

4.5. Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:

4.5.1. OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought to the site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible.

4.5.2. CONTRACTOR shall immediately: (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23), and (ii) notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefor as provided in Articles 11 and 12.

4.5.3. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefor as provided in Articles 11 and 12. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

4.5.4. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's

Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) nothing in this subparagraph 4.5.4 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

4.5.5. The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site.

ARTICLE 5—BONDS AND INSURANCE

Performance, Payment and Other Bonds:

5.1. CONTRACTOR shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within ten days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

5.3. Licensed Sureties and Insurers; Certificates of Insurance:

5.3.1. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance

companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3.2. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.4. OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7 hereof.

CONTRACTOR's Liability Insurance:

5.4. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.4.1. claims under workers' compensation, disability benefits and other similar employee benefit acts;

5.4.2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

5.4.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

5.4.4. claims for damages insured by customary personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5.4.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

5.4.6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7. with respect to insurance required by paragraphs 5.4.3 through 5.4.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers and employees of all such additional insureds;

5.4.8. include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

5.4.9. include completed operations insurance;

5.4.10. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.12, 6.16 and 6.31 through 6.33;

5.4.11. contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.3.2 will so provide);

5.4.12. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing defective Work in accordance with paragraph 13.12; and

5.4.13. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

OWNER's Liability Insurance:

5.5. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.4, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Property Insurance:

5.6. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insur-

ance upon the Work at the site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.6.2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework and Work in transit and shall insure against at least the following perils fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions;

5.6.3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.6.4. cover materials and equipment stored at the site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER; and

5.6.5. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

5.8. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.11.

5.9. OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount, will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraphs 5.6 or 5.7, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

5.11. *Waiver of Rights:*

5.11.1. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraphs 5.6 and 5.7 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds in such policies and will provide primary coverage for all losses and damages caused by the perils covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11.2. In addition, OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them, for:

5.11.2.1. loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of or resulting from fire or other peril, whether or not insured by OWNER; and

5.11.2.2. loss or damage to the completed Project or part thereof caused by, arising out of or resulting from fire or other insured peril covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.10, after substantial completion pursuant to paragraph 14.8 or after final payment pursuant to paragraph 14.13.

Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in this paragraph 5.11.2 shall contain provisions to the effect that in the event of payment of any such loss, damage or consequential loss the insurers will have no rights of recovery against any of CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them.

Receipt and Application of Insurance Proceeds

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

Acceptance of Bonds and Insurance; Option to Replace:

5.14. If either party (OWNER or CONTRACTOR) has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within ten days after receipt of the certificates (or other evidence requested) required by paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was

required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

Partial Utilization—Property Insurance:

5.15. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6—CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1. CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours and

CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4. Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

Progress Schedule:

6.6. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.9 as it may be adjusted from time to time as provided below:

6.6.1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.9) proposed adjustments in the progress schedule that will not change the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

6.6.2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of paragraph 12.1. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.7. *Substitutes and "Or-Equal" Items:*

6.7.1. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by ENGINEER under the following circumstances:

6.7.1.1. *"Or-Equal"*: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

6.7.1.2. *Substitute Items*: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under subparagraph 6.7.1.1, it will be considered a proposed substitute item. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by the ENGINEER will include the following as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall first make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute.

6.7.1.3. *CONTRACTOR's Expense*: All data to be provided by CONTRACTOR in support of any proposed "or-equal" or substitute item will be at CONTRACTOR's expense.

6.7.2. *Substitute Construction Methods or Procedures*: If a specific means, method, technique, sequence or procedure of

construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.7.1.2.

6.7.3. *Engineer's Evaluation*: ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.7.1.2 and 6.7.2. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitutes proposed or submitted by CONTRACTOR pursuant to paragraphs 6.7.1.2 and 6.7.2 and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER accepts a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute item.

Concerning Subcontractors, Suppliers and Others:

6.8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials or equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be adjusted by the difference in the cost occasioned by such

substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work.

6.9.1. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.9.2. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

6.10. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.6 or 5.7, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

Patent Fees and Royalties:

6.12. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance

of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents.

Permits:

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Laws and Regulations:

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.14.2. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses and damages caused by, arising out of or resulting therefrom; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.3.2.

Taxes:

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of

the Project which are applicable during the performance of the Work.

Use of Premises:

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. CONTRACTOR shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of

the Work, these record documents, Samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection:

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1. all persons on the Work site or who may be affected by the Work;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

Safety Representative:

6.21. CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and

responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

Hazard Communication Programs:

6.22. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with Laws or Regulations.

Emergencies:

6.23. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.24. Shop Drawings and Samples:

6.24.1. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9). All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.26.

6.24.2. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

6.25. Submittal Procedures:

6.25.1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

6.25.1.1. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto,

6.25.1.2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and

6.25.1.2. all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

6.25.2. Each submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR'S review and approval of that submittal.

6.25.3. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals accepted by ENGINEER as required by paragraph 2.9. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract

Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.25.1.

6.28. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submissions accepted by ENGINEER as required by paragraph 2.9, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6.29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.30. CONTRACTOR's General Warranty and Guarantee:

6.30.1. CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be *defective*. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

6.30.1.1. abuse, modification or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors or Suppliers; or

6.30.1.2. normal wear and tear under normal usage.

6.30.2. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

6.30.2.1. observations by ENGINEER;

6.30.2.3. recommendation of any progress or final payment by ENGINEER;

6.30.2.3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

6.30.2.4. use or occupancy of the Work or any part thereof by OWNER;

6.30.2.5. any acceptance by OWNER or any failure to do so;

6.30.2.6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13;

6.30.2.7. any inspection, test or approval by others; or

6.30.2.8. any correction of *defective* Work by OWNER.

Indemnification:

6.31. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused by, arising out of or resulting from the performance of the Work, provided that any such claim, cost, loss or damage: (i) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.32. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier or other person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.33. The indemnification obligations of CONTRACTOR under paragraph 6.31 shall not extend to the liability of ENGINEER and ENGINEER's Consultants, officers, directors, employees or agents caused by the professional negligence, errors or omissions of any of them.

Survival of Obligations:

6.34. All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with

the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

ARTICLE 7—OTHER WORK

Related Work at Site:

7.1. OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefor which shall contain General Conditions similar to these, or have other work performed by utility owners. If the fact that such other work is to be performed was not noted in the Contract Documents, then: (i) written notice thereof will be given to CONTRACTOR prior to starting any such other work, and (ii) CONTRACTOR may make a claim therefor as provided in Articles 11 and 12 if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the additional work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure so to report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in such other work.

Coordination:

7.4. If OWNER contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1. the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

7.4.2. the specific matters to be covered by such authority and responsibility will be itemized; and

7.4.3. the extent of such authority and responsibilities will be provided.

Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8—OWNER'S RESPONSIBILITIES

8.1. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.3. OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and drawings of physical conditions in existing structures at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents.

8.5. OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8. In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

8.9. The OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.10. OWNER'S responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Materials uncovered or revealed at the site is set forth in paragraph 4.5.

8.11. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9—ENGINEER'S STATUS DURING CONSTRUCTION

OWNER's Representative:

9.1. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

Visits to Site:

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defective Work. ENGINEER's visits and on-site observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.13, and particularly, but without limitation, during or as a result of ENGINEER's on-site visits or

observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

Project Representative:

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.13 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other person will be as provided in the Supplementary Conditions.

Clarifications and Interpretations:

9.4. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER or CONTRACTOR believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree to the amount or extent thereof, if any, OWNER or CONTRACTOR may make a written claim therefor as provided in Article 11 or Article 12.

Authorized Variations in Work:

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR who shall perform the Work involved promptly. If OWNER or CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree as to the amount or extent thereof, OWNER or CONTRACTOR may make a written claim therefor as provided in Article 11 or 12.

Rejecting Defective Work:

9.6. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be defective, or

that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

9.8. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

9.9. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

Determinations for Unit Prices:

9.10. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other and to ENGINEER written notice of intention to appeal from ENGINEER's decision and: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in Exhibit GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to ENGINEER's decision, unless otherwise agreed in writing by OWNER and CONTRACTOR. Such appeal will not be subject to the procedures of paragraph 9.11.

Decisions on Disputes:

9.11. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and Claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant

to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after the start of such occurrence or event unless ENGINEER allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to ENGINEER and the claimant within thirty days after receipt of the claimant's last submittal (unless ENGINEER allows additional time). ENGINEER will render a formal decision in writing within thirty days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. ENGINEER's written decision on such claim, dispute or other matter will be final and binding upon OWNER and CONTRACTOR unless: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in EXHIBIT GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within thirty days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim, dispute or other matter in accordance with applicable Laws and Regulations within sixty days of the date of such decision, unless otherwise agreed in writing by OWNER and CONTRACTOR.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 or 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant to Article 16.

9.13. Limitations on ENGINEER's Authority and Responsibilities:

9.13.1. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise or performance of any authority or responsibility by ENGINEER shall create, impose or give rise to any duty owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them.

9.13.2. ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Sub-contractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

9.13.4. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and Other documentation required to be delivered by paragraph 14.12 will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with, the Contract Documents.

9.13.5. The limitations upon authority and responsibility set forth in this paragraph 9.13 shall also apply to ENGINEER's Consultants, Resident Project Representative and assistants.

ARTICLE 10—CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefor as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.5 and 3.6 except in the case of an emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

10.4.1. changes in the Work which are (i) ordered by OWNER pursuant to paragraph 10.1, (ii) required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11—CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after the start of such occurrence or event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the adjustment claimed covers all known amounts to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will

be valid if not submitted in accordance with this paragraph 11.2.

11.3. The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows:

11.3.1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3, inclusive);

11.3.2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2);

11.3.3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 11.6).

Cost of the Work:

11.4. The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5:

11.4.1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen and other personnel employed full-time at the site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the

cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3. Payments made by CONTRACTOR to the Subcontractors for Work performed or furnished by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids, if any, will be accepted. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in paragraphs 11.4, 11.5, 11.6 and 11.7. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof—all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4—all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

11.5.2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

11.5.3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

11.6. The CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee; or

11.6.2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2, the CONTRACTOR's fee shall be fifteen percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the CONTRACTOR's fee shall be five percent;

11.6.2.3. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 11.4.1, 11.4.2, 11.4.3 and 11.6.2 is that the Subcontractor who actually performs or furnishes the Work, at whatever tier, will be paid a fee of fifteen percent of the costs incurred by such Subcontractor under paragraphs 11.4.1 and 11.4.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

11.6.2.4. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.5. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and

11.6.2.5. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.5, inclusive.

11.7. Whenever the cost of any Work is to be determined pursuant to paragraphs 11.4 and 11.5, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

11.8.1. the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.9. Unit Price Work:

11.9.1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with paragraph 9.10.

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

11.9.3. OWNER or CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

11.9.3.2. there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result

of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12—CHANGE OF CONTRACT TIMES

12.1. The Contract Times (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times (or Milestones) shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Times (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a claim is made therefor as provided in paragraph 12.1. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.4. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay. In no event shall OWNER be liable to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of CONTRACTOR, or (ii)

delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

**ARTICLE 13—TESTS AND INSPECTIONS;
CORRECTION, REMOVAL OR
ACCEPTANCE OF DEFECTIVE WORK**

13.1. *Notice of Defects:* Prompt notice of all *defective Work* of which OWNER or ENGINEER have actual knowledge will be given to CONTRACTOR. All *defective Work* may be rejected, corrected or accepted as provided in this Article 13.

Access to Work:

13.2. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

Tests and Inspections:

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.4. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

13.4.1. for inspections, tests or approvals covered by paragraph 13.5 below;

13.4.2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3. as otherwise specifically provided in the Contract Documents.

13.5. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body. CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection, or

approval. CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

13.6. If any Work (or the work of others) that is to be inspected, tested or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

13.7. Uncovering Work as provided in paragraph 13.6 shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

Uncovering Work:

13.8. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefor as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

OWNER May Stop the Work:

13.10. If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work

shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any surety or other party.

Correction or Removal of Defective Work:

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with Work that is not *defective*. CONTRACTOR shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.12. Correction Period:

13.12.1. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with Work that is not *defective*, and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.

13.12.2. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

13.12.3. Where *defective* Work (and damage to other Work resulting therefrom) has been corrected, removed or replaced under this paragraph 13.12, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

Acceptance of Defective Work:

13.13. If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall

pay all claims, costs, losses and damages attributable to OWNER's evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors and ENGINEER and ENGINEER's Consultants access to the site to enable OWNER to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by OWNER in exercising such rights and remedies will be charged against CONTRACTOR and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14—PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1. The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and

will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment:

14.2. At least twenty days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

Review of Applications for Progress Payment:

14.4. ENGINEER will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

14.5.1. the Work has progressed to the point indicated,

14.5.2. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation), and

14.5.3. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or (ii) that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

14.6. ENGINEER's recommendation of any payment, including final payment, shall not mean that ENGINEER is responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work, or for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.5. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1. the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

14.7.5. claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work.

14.7.6. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens,

14.7.7. there are other items entitling OWNER to a set-off against the amount recommended, or

14.7.8. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.7.1 through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

Substantial Completion:

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform

ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10. Use by OWNER at OWNER's option of any substantially completed part of the Work which: (i) has specifically been identified in the Contract Documents, or (ii) OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.10.2. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all

particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

Final Application for Payment:

14.12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.4.13, (ii) consent of the surety, if any, to final payment, and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu of such releases or waivers of Liens and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and (ii) all payrolls, material and equipment bills and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

Final Payment and Acceptance:

14.13. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after the presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to

CONTRACTOR.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Waiver of Claims:

14.15. The making and acceptance of final payment will constitute:

14.15.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.11, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

14.15.2. a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

ARTICLE 15—SUSPENSION OF WORK AND TERMINATION

OWNER May Suspend Work:

15.1. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

OWNER May Terminate:

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as adjusted from time to time pursuant to paragraph 6.6);

15.2.2. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.2. if CONTRACTOR disregards the authority of ENGINEER; or

15.2.4. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by OWNER arising out of or resulting from completing the Work such excess will be paid to CONTRACTOR. If such claims, costs, losses and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and when so approved by ENGINEER incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

15.4.1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

15.4.2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

15.4.3. for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

15.4.4. for reasonable expenses directly attributable to termination.

CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

CONTRACTOR May Stop Work or Terminate:

15.5. If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within thirty days after it is submitted, or OWNER has failed for thirty days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may upon seven day's written notice to OWNER and ENGINEER stop the Work until payment of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude CONTRACTOR from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this paragraph.

ARTICLE 16—DISPUTE RESOLUTION

If and to the extent that OWNER and CONTRACTOR have agreed on the method and procedure for resolving disputes between them that may arise under this Agreement, such dispute resolution method and procedure, if any, shall be as set forth in Exhibit GC-A, "Dispute Resolution Agreement," to be attached hereto and made a part hereof. If no such agreement on the method and procedure for resolving such disputes has been reached, and subject to the provisions of paragraphs 9.10, 9.11, and 9.12, OWNER and CONTRACTOR may exercise

such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17—MISCELLANEOUS

Giving Notice:

17.1. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Times:

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

Notice of Claim:

17.3. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or

act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

Cumulative Remedies:

17.4. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.12, 6.16, 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

Professional Fees and Court Costs Included:

17.5. Whenever reference is made to "claims, costs, losses and damages," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

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**EXHIBIT GC-A to General Conditions of the
Agreement Between OWNER and CON-
TRACTOR Dated _____
For use with EJCDC No. 1910-8 (1990 ed.)**

DISPUTE RESOLUTION AGREEMENT

OWNER and CONTRACTOR hereby agree that Article 16 of the General Conditions to the Agreement between OWNER and CONTRACTOR is amended to include the following agreement of the parties:

16.1. All claims, disputes and other matters in question between OWNER and CONTRACTOR arising out of or relating to the Contract Documents or the breach thereof (except for claims which have been waived by the making or acceptance of final payment as provided by paragraph 14.15) will be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining, subject to the limitations of this Article 16. This agreement so to arbitrate and any other agreement or consent to arbitrate entered into in accordance herewith as provided in this Article 16 will be specifically enforceable under the prevailing law of any court having jurisdiction.

16.2. No demand for arbitration of any claim, dispute or other matter that is required to be referred to ENGINEER initially for decision in accordance with paragraph 9.11 will be made until the earlier of (a) the date on which ENGINEER has rendered a written decision or (b) the thirty-first day after the parties have presented their evidence to ENGINEER if a written decision has not been rendered by ENGINEER before that date. No demand for arbitration of any such claim, dispute or other matter will be made later than thirty days after the date on which ENGINEER has rendered a written decision in respect thereof in accordance with paragraph 9.11; and the failure to demand arbitration within said thirty days' period will result in ENGINEER's decision being final and binding upon OWNER and CONTRACTOR. If ENGINEER renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but will not supersede the arbitration proceedings, except where the decision is acceptable to the parties concerned. No demand for arbitration of any written decision of ENGINEER rendered in accordance with paragraph 9.10 will be made later than ten days after the party making such demand has delivered written notice of intention to appeal as provided in paragraph 9.10.

16.3. Notice of the demand for arbitration will be filed in writing with the other party to the Agreement and with the

American Arbitration Association, and a copy will be sent to ENGINEER for information. The demand for arbitration will be made within the thirty-day or ten-day period specified in paragraph 16.2 as applicable, and in all other cases within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

16.4. Except as provided in paragraph 16.5 below, no arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder or in any other manner any other person or entity (including ENGINEER, ENGINEER's Consultant and the officers, directors, agents, employees or consultants of any of them) who is not a party to this contract unless:

16.4.1. the inclusion of such other person or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration, and

16.4.2. such other person or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings, and

16.4.3. the written consent of the other person or entity sought to be included and of OWNER and CONTRACTOR has been obtained for such inclusion, which consent shall make specific reference to this paragraph; but no such consent shall constitute consent to arbitration of any dispute not specifically described in such consent or to arbitration with any party not specifically identified in such consent.

16.5. Notwithstanding paragraph 16.4 if a claim, dispute or other matter in question between OWNER and CONTRACTOR involves the Work of a Subcontractor, either OWNER or CONTRACTOR may join such Subcontractor as a party to the arbitration between OWNER and CONTRACTOR hereunder. CONTRACTOR shall include in all subcontracts required by paragraph 6.11 a specific provision whereby the Subcontractor consents to being joined in an arbitration between OWNER and CONTRACTOR involving the Work of such Subcontractor. Nothing in this paragraph 16.5 nor in the provision of such subcontract consenting to joinder shall create any claim, right or cause of action in favor of Subcontractor and against OWNER, ENGINEER or ENGINEER's Consultants that does not otherwise exist.

16.6. The award rendered by the arbitrators will be final, judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal.

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16.7. OWNER and CONTRACTOR agree that they shall first submit any and all unsettled claims, counterclaims, disputes and other matters in question between them arising out of or relating to the Contract Documents or the breach thereof ("disputes"), to mediation by The American Arbitration Association under the Construction Industry Mediation Rules of the American Arbitration Association prior to either of them initiating against the other a demand for arbitration pursuant to paragraphs 16.1 through 16.6, unless delay in initiating arbitra-

tion would irrevocably prejudice one of the parties. The respective thirty and ten day time limits within which to file a demand for arbitration as provided in paragraphs 16.2 and 16.3 above shall be suspended with respect to a dispute submitted to mediation within those same applicable time limits and shall remain suspended until ten days after the termination of the mediation. The mediator of any dispute submitted to mediation under this Agreement shall not serve as arbitrator of such dispute unless otherwise agreed.

Document 008000

SUPPLEMENTARY CONDITIONS

PART 1 – GENERAL

1.01 SUMMARY

- A. These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (Engineers Joint Contract Documents Committee –EJCDC Document No. 1910-8, 1990 edition) and other provisions of the Contract as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

PART 2 – CHANGES TO GENERAL CONDITIONS

2.01 ARTICLE 1 – DEFINITIONS

- A. The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them therein. In addition, wherever used in these Supplementary Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to the singular and plural thereof.
 - 1. “ARCHITECT/ENGINEER” is further defined to be JR Miller & Associates, Inc. “CQA FIRM” is further defined to be _____.
 - 2. Site of the Work: The area to be occupied by the Project and all adjacent areas and other related areas occupied or used by the CONTRACTOR or his subcontractors during performance of the Work, including storage areas and buildings, staging areas, and areas for the production, procurement, storage, and disposal of earthwork, concrete and paving materials, and similar materials and equipment. The use of the word “jobsite” or “site” in the Project Manual shall be interpreted to be synonymous with Site of the Work.
 - 3. Force Account: Wherever in the Project Manual the term “Force Account” is used to describe a method of compensation, it shall be understood to mean the method specified in Paragraph 11.3.3 (modified in this specification section) of the General Conditions, i.e., Cost of the Work Plus a Fee.

2.02. ARTICLE 2 – PRELIMINARY MATTERS

- A. Paragraph 2.3 of the General Conditions: delete in its entirety and insert the following in its place:

2.3 The Contract Time will commence to run on the date indicated in the Notice to Proceed. Any Work undertaken by CONTRACTOR prior to the date indicated in the Notice to Proceed will be entirely at his own risk.

- B. Paragraph 2.5 of the General Conditions: Insert the following at the end of the paragraph:

If CONTRACTOR, before receiving orders or instructions from the ARCHITECT/ENGINEER, performs any portion of the work affected by such apparent conflict or discrepancy, such performance shall be at his own risk, and he shall not be entitled to additional compensation or time by reason of the conflict or discrepancy or its later correction.

- C. Paragraph 2.6 of the General Conditions: delete in its entirety.

- D. Paragraph 2.8 of the General Conditions: delete in its entirety and insert the following in its place:

2.8 A preconstruction conference attended by the CONTRACTOR, ARCHITECT/ENGINEER and OWNER will be held at an appropriate time after the Notice to Proceed has been issued. The purpose of this meeting will be to discuss the schedules required under Section 013000 of the Specifications, to discuss procedures for handling shop drawings and other submittals, and to establish a working understanding among the parties as to the Work.

- E. Paragraph 2.9 of the General Conditions: delete in its entirety and insert the following in its place:

2.9 The CONTRACTOR shall obtain approval of the various schedules specified in Section 013000, Submittals, before submitting the first application for payment.

2.03 ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

- A. Paragraph 4.2 of the General Conditions: add new paragraphs as follows:

4.2.7 No claim of the CONTRACTOR under this clause shall be allowed unless the CONTRACTOR has given the notice required in Paragraph 4.2; provided, however, the time prescribed therefore may be extended by the OWNER.

4.2.8 No claim by the CONTRACTOR for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

- B. Paragraph 4.3 of the General Conditions: delete in its entirety.
- C. Paragraph 4.4 of the General Conditions: change the first sentence to read as follows:

The OWNER shall provide a minimum of four horizontal and vertical control points for each building, which, in the ARCHITECT/ENGINEER’S judgment, are necessary to enable CONTRACTOR to proceed with the Work in accordance with the Bid Documents.

2.04 ARTICLE 5 – BONDS AND INSURANCE

- A. The limits of liability for the insurance required by paragraph 5.4 (CONTRACTOR’S Liability Insurance) of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

- 1. Workers’ Compensation, etc., under paragraph 5.4.1 of the General Conditions:
 - a. State: Statutory
 - b. Applicable Federal (e.g. Longshoreman’s): Statutory
 - c. Employer’s Liability: \$1,000,000
- 2. Comprehensive General Liability under paragraph 5.4.2 through 5.4.8 of the General Conditions:
 - a. Bodily injury (including completed operations and products liability):

\$1,000,000	Each Occurrence
\$2,000,000	Annual Aggregate
 - b. Personal Injury, with employment exclusion deleted:

\$2,000,000	Annual Aggregate
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 - c. Property Damage:

\$1,000,000 Each Occurrence

\$2,000,000 Annual Aggregate

d. Property Damage liability insurance shall provide Explosion, Collapse and Underground coverages where applicable.

3. Comprehensive Automobile Liability under paragraph 5.7 of the General Conditions:

a. Bodily Injury:

\$1,000,000 Each Person

\$1,000,000 Each Occurrence

b. Property Damage:

\$1,000,000 Each Occurrence

B. The Contractual Liability required by paragraph 5.4.10 of the General Conditions shall provide coverage for not less than the following amounts:

5.4.1. Bodily Injury:

\$1,000,000 Each Occurrence

5.4.2. Property Damage:

\$1,000,000 Each Occurrence

\$2,000,000 Annual Aggregate

C. Paragraph 5.6 of the General Conditions: delete in its entirety and insert the following in its place:

5.6 Unless otherwise provided in these Supplementary Conditions, CONTRACTOR shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or as required by law). This insurance shall include the interests of the OWNER, CONTRACTOR and Subcontractors in the work, shall insure against the perils of fire and extended coverage, shall include "all risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in these Supplementary Conditions, and shall

include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all risk" insurance or otherwise provided in these Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.6 and 5.7 shall contain a provision that the coverage afforded will not be cancelled or materially changed until at least thirty calendar days' prior written notice has been given to OWNER.

2.05 ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

- A. Paragraph 6.5 of the General Conditions add the following:

Any deviation from the manufacturer’s printed recommendations shall be explained and acknowledged as correct for the circumstances, in writing, by the manufacturer.

- B. Paragraph 6.6 of the General Conditions: insert the following at the end of paragraph:

The time limit set forth in the Project Manual for substantial completion (as extended or shortened pursuant to Article 12) shall govern, and the schedule shall be adjusted to meet such time limits.

- C. Paragraph 6.6 of the General Conditions: add new paragraphs as follows:

6.6.3 If the progress of the Work is deemed unsatisfactory in accordance with this provision, OWNER may withhold progress payments pursuant to Article 14.7 of the General Conditions.

6.6.4 In the event the Contract Time is adjusted pursuant to Article 12, the CONTRACTOR’S schedule shall be revised to correspond with the adjustment.

- D. Paragraph 6.8.3: add new paragraph to the General Conditions as follows:

6.8.3 Except as provided in the foregoing paragraphs 6.8.1 and 6.8.2, no substitution of subcontractors from those listed with the CONTRACTOR’S Bid will be permitted without the written consent of OWNER.

- E. Paragraph 6.15: add new paragraph to the General Conditions as follows:

6.15.1 The CONTRACTOR shall accept exclusive liability and hold the OWNER harmless for payment of social security taxes, unemployment insurance, worker's compensation, contributions, and other taxes measured by wages of employees employed upon the Work.

F. Paragraph 6.16: add new paragraphs to the General Conditions as follows:

6.16.1 CONTRACTOR shall examine all documents covering rights of way, permits and easements. CONTRACTOR shall comply with all terms and conditions contained in such documents.

6.16.2 CONTRACTOR shall comply with the requirements of OWNER'S site Regulations.

G. Paragraph 6.20: add new paragraph to the General Conditions as follows:

6.20.4 Spills

6.20.4.1 In the event that CONTRACTOR spills any hazardous material, including fuel or oil for equipment, the location, amount and type of material spilled shall be reported to the OWNER. This information is necessary to determine the spill's effect on ground water monitoring at the site.

6.20.4.2 In the event that CONTRACTOR spills any hazardous material, including fuel or oil that the CONTRACTOR spills, the CONTRACTOR shall be responsible for all costs and work to remediate such spill. Remediation will be as directed by the OWNER.

2.06 ARTICLE 7 – OTHER WORK

A. Paragraph 7.4 of the General Conditions: Add new paragraphs as follows:

7.5 The project site is located within the Monterey Peninsula Landfill which is an active Class III waste disposal facility as defined by California Code of Regulations, Title 23, Chapter 15, Article 3. The OWNER will have full authority and responsibility for activities related to waste disposal operations and for coordination of the waste disposal operations with the work of the CONTRACTOR. Areas of mutual concern include but are not limited to allocation of unloading areas and areas of common use, requirements of a dust-free atmosphere, absence of vibration or noise or natural light, and the like.

7.6 The Contract Drawings include work identified to be performed by the OWNER concurrently with work being performed by the CONTRACTOR. The CONTRACTOR shall coordinate his schedule with the work schedule of the

OWNER and the OWNER shall cooperate with the CONTRACTOR to schedule and perform the work described in Bid Documents, so as not to adversely impact the CONTRACTOR'S schedule or work.

7.7 The ENGINEER, as OWNER'S representative, will coordinate the work of this Monterey Peninsula Landfill Contract.

2.07 ARTICLE 8 – OWNER'S RESPONSIBILITY

- A. Paragraph 8.1 of the General Conditions: amend the first sentence by striking out the words "through ENGINEER."

2.08 ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

- A. Paragraph 9.2 of the General Conditions: delete in its entirety.
- B. Paragraph 9.3 of the General Conditions: delete in its entirety and insert the following in its place:

9.3 The ENGINEER will observe the performance and quality of the Work, perform inspections and tests, review and verify quantities, approve progress payments, and, in general, administer the Contract. The ENGINEER will keep the OWNER informed of the progress of the Work and will endeavor to guard the OWNER against defects and deficiencies in the Work.

- C. Paragraph 9.11 of the General Conditions: delete in its entirety and insert the following in its place:

9.11 The ENGINEER, as the OWNER'S representative, will be the initial interpreter of the requirements of the Project Manual and will determine the acceptability of the work performed thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Project Manual pertaining to performance and furnishing of the Work and Claims under Articles 11 and 12, in respect to changes in the Contract Price or Contract Time, shall be referred, initially, to the ENGINEER in writing. Such written notice of claim, dispute or other matter shall be delivered by the claimant to the ENGINEER and the other party to the Agreement promptly (but in no event later than 15 calendar days) after the occurrence of the event giving rise thereto. Written supporting data shall be submitted to the ENGINEER and the other party within 30 calendar days after such occurrence unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

9.11.1 In presenting the claim, dispute, or other matter, the party raising the issue shall specifically include, to the extent then possible, the following:

9.11.1.1 The Contract provisions which apply to the matter and under which the claim or dispute is made;

9.11.1.2 The Bid items and quantities, if any, upon which the claim is based.

9.11.1.3 The specific relief requested, including but not limited to, increase or decrease of the Contract Price and/or extension or shortening of the Contract Time.

9.11.2 The claim will be acknowledged in writing by the ENGINEER. If the claim is not disposed of within 30 calendar days by meetings or other process of negotiation which results in agreement, the ENGINEER will make a written recommendation on the claim. The recommendation of the ENGINEER will be delivered to both the OWNER and the CONTRACTOR. The recommendation of the ENGINEER will be subject to the approval of the OWNER.

9.11.3 After the OWNER receives the ENGINEER'S formal recommendation, the OWNER shall have the right to make written request to the CONTRACTOR at any time for additional information which the CONTRACTOR may possess to clarify the claim. The CONTRACTOR shall provide such additional information within 30 calendar days after it is requested by the OWNER. The OWNER may allow a reasonable time extension for good cause if the CONTRACTOR presents a written request for the time extension prior to the expiration of the 30 calendar days. If the CONTRACTOR fails to furnish the additional information requested by the OWNER, the CONTRACTOR will be deemed to have waived its claim.

9.11.4 Within 90 calendar days after receipt of all necessary information, the OWNER will issue a written decision on the claim, dispute, or other matter. The decision of the OWNER constitutes the exhaustion of contractual and administrative remedies. The OWNER'S decision shall be final and conclusive unless it is fraudulent or unless the CONTRACTOR commences action through a Court of Proper Jurisdiction within 120 calendar days from receipt thereof.

9.11.5 Wherever in the Project Manual reference is made to "appeals," "claims," "review by the ENGINEER," or other similar phrases, such reference shall be construed to mean review in accordance with the provisions in Paragraph 9.11.

D. Paragraph 9.12 of the General Conditions: delete in its entirety.

2.09 ARTICLE 11 – CHANGE OF CONTRACT PRICE

- A. Force Account: See Paragraph 2.01, Subparagraph A.2 of these Supplementary Conditions.
- B. Paragraph 11.2 of the General Conditions, second sentence: delete the words “thirty days” and replace with “seven days.”
- C. Paragraph 11.2 of the General Conditions, third sentence: delete the words “sixty days” and replace with “twenty-one days.” Also, delete the word “known.”
- D. Paragraph 11.2 of the General Conditions: revise the last sentence and add new subparagraphs as follows:

No claim for an adjustment in Contract Price will be valid if not submitted in accordance with this paragraph 11.2 and, in the case of a claim by the CONTRACTOR for an increase in the Contract Price to be determined by mutual acceptance of a unit price or lump sum as provided in paragraph 11.3.2, if the supporting data does not include all of the following as applicable:

11.2.1 Labor cost calculation showing hourly base rate and fringe benefits for each craft employed, and showing crew composition and productivity rates for each operation required.

11.2.2 Calculation sheets showing derivation of all quantities.

11.2.3 Permanent material cost calculation showing unit prices and quantities with waste allowances.

11.2.4 Permanent equipment cost calculation supported by copies of quotations or purchase orders.

11.2.5 Calculation of cost of non-permanent construction supplies.

11.2.6 Construction equipment cost calculation showing hours used, hourly rate, and productivity rate, where applicable.

11.2.7 Overhead calculation showing percentages added for small tools, field offices, supervision, home office overhead, and other miscellaneous costs.

11.2.8 Profit.

- E. Paragraph 11.3 of the General Conditions: delete in its entirety and insert the following in its place:

11.3 The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

11.3.1 Where, as determined by the ENGINEER, the work is covered by unit prices contained in the Contract by application of those unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3, inclusive).

11.3.2 By mutual acceptance of a lump sum or a new unit price or prices.

11.3.3 On the basis of the Cost of the Work (determined as provided in paragraphs 11.4, 11.5, and 11.7) plus a CONTRACTOR'S Fee for overhead and profit (determined as provided in paragraph 11.6). In proceeding with any work in response to a Work Directive Change, or any other work for which the CONTRACTOR believes he may be entitled to an adjustment in the Contract Price, in the absence of an executed Change Order specifying adjustment in the Contract Price pertaining to such work, the CONTRACTOR shall maintain records as provided in paragraph 11.7 so that subsequently, if agreement cannot be reached pursuant to paragraphs 11.3.1 or 11.3.2, the necessary data will be available to enable a determination pursuant to this paragraph 11.3.3. Should the CONTRACTOR fail to maintain such records, the Cost of the Work will be determined by the ENGINEER based upon his own records or, if the ENGINEER has not been present to observe the work in progress and record the cost elements thereof, based upon the ENGINEER'S best estimate of the reasonable Cost of the Work.

- F. Paragraph 11.4.1 of the General Conditions, fourth sentence: modify to read as follows:
- Such employees shall include workers and foremen at the site and shall exclude superintendents and other management personnel above the rank of foreman.
- G. Paragraphs 11.4.5.1, 11.4.5.2, 11.4.5.7, 11.4.5.8 and 11.4.5.9 of the General Conditions: delete in their entirety.
- H. Paragraph 11.5.4 of the General Conditions: modify by striking out the words "(except for the cost of premiums covered by subparagraph 11.4.5.9 above)."
- I. Subparagraph 11.5.5 of the General Conditions: add new subparagraphs to read as follows:
- 11.5.6 Transportation, travel, and subsistence expenses of CONTRACTOR'S employees and those of any subcontractor.

11.5.7 Cost including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, whether or not consumed in the performance of the Work.

11.5.8 The cost of utilities, fuel and sanitary facilities at the site.

11.5.9 Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, postage and similar petty cash items in connection with the Work.

- J. Paragraph 11.6.2 of the General Conditions: delete in its entirety, and insert the following in its place:

11.6.2 A fee based upon the following percentages of the various portions of the Cost of the Work:

11.6.2.1 For costs incurred under paragraph 11.4.1, the CONTRACTOR'S fee shall be 15 percent;

11.6.2.2 For costs incurred under paragraph 11.4.2, the CONTRACTOR'S fee shall be 10 percent;

11.6.2.3 For costs incurred under paragraph 11.4.3, the CONTRACTOR'S fee shall be 5 percent, and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to CONTRACTOR on account of overhead and profit of all Subcontractors shall be 15 percent for labor and 10 percent for materials;

11.6.2.4 No fee shall be payable on the basis of costs itemized under paragraphs 11.4.4 and 11.4.5.

- K. Paragraph 11.7 of the General Conditions: delete in its entirety and insert the following in its place:

11.7 The CONTRACTOR shall maintain his records to provide a clear distinction between the costs of work paid for on a Cost of the Work plus a Fee basis and the costs of other operations.

11.7.1 The CONTRACTOR shall prepare and furnish to the ENGINEER, on the following work day, report sheets in duplicate of each day's work paid for on a Cost of the Work plus a Fee basis. The daily report sheets shall itemize the materials used and shall cover the direct cost of labor and the charges for equipment, whether furnished by the CONTRACTOR, subcontractor, or other forces. The daily report sheets shall provide names or identifications and

classifications of workmen, the hourly rate of pay and hours worked, and the size, type and identification number of equipment, and hours operated. Daily report sheets shall be signed by the CONTRACTOR or his authorized agent.

11.7.2 Material charges shall be substantiated by valid copies of vendor's invoices. Such invoices shall be submitted with the daily report sheets, or if not available, they shall be submitted with subsequent daily report sheets. Should the vendor's invoices not be submitted within 20 calendar days after the date of delivery of the material or 15 calendar days after acceptance of the work, whichever comes first, the ENGINEER reserves the right to establish the cost of such materials at the lowest current wholesale prices at which such materials are available in the quantities concerned and delivered to the location of the work, less any discounts provided in Article 11.4.2.

11.7.3 The ARCHITECT/ENGINEER will compare his records with the daily report sheets furnished by the CONTRACTOR, make any necessary adjustments, and compile the costs of work paid for on a Cost of the Work plus a Fee basis on daily report forms furnished by the ENGINEER. When these daily reports are agreed upon and signed by the ENGINEER, they shall become the basis of payment for the work performed, but shall not preclude subsequent adjustment based on a later audit.

11.7.4 The CONTRACTOR'S original cost records pertaining to work paid for on a Cost of the Work plus a Fee basis shall be retained and shall be open to inspection and audit as may be required by other provisions of the Contract.

L. Paragraph 11.8 of the General Conditions: delete in its entirety.

M. Paragraph 11.9.3 of the General Conditions: add the following new paragraphs:

11.9.4 Increased or Decreased Quantities:

11.9.4.1 For Bid Items paid for on a unit price basis, increases or decreases in quantity of a Bid Item will be determined by comparing the total pay quantity of the Bid Item with the ENGINEER'S estimated quantity in the Bid Schedule.

11.9.4.2 If the total pay quantity of a Bid Item, which has a total value of two percent or more of the total Contract Bid price, varies from the ARCHITECT/ENGINEER'S quantity estimate by 25 percent or less, payment for the Bid Item will be made at the Contract unit price. If the total pay quantity of a Bid Item varies from the ARCHITECT/ENGINEER'S quantity estimate by more than 25 percent, the compensation payable to the CONTRACTOR will be subject to review by the CONTRACTOR and the ENGINEER, and an equitable adjustment will be made by means of a Change Order to credit the OWNER with any reduction in

cost or to compensate the CONTRACTOR for any increase in cost resulting from variations between estimated and actual pay quantities. The adjustment review will be made at a time mutually acceptable to the ARCHITECT/ENGINEER and the CONTRACTOR.

11.9.4.3 Payment for a Bid Item which has a final total value of less than two percent of the total Contract Price will be made at the Contract unit price regardless of increased or decreased quantities.

2.10 ARTICLE 12 – CHANGE OF CONTRACT TIMES

- A. Paragraph 12.1 of the General Conditions, second sentence: delete the words “thirty days” and substitute with “seven calendar days.”
- B. Paragraph 12.1 of the General Conditions, third sentence: delete the words “sixty days” and substitute with “thirty calendar days.”

2.11 ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

- A. Paragraph 13.1 of the General Conditions: add new subparagraphs to read as follows:

13.1.1 Unless otherwise provided elsewhere in the Contract, all materials and equipment incorporated into any work covered by the Contract shall be of the quality specified and, where not specified, of a grade suitable for their intended use and in conformance with the Specifications, Drawings, Samples and other descriptions set forth in this Agreement. CONTRACTOR warrants all equipment, materials and labor furnished or performed under this Contract against defects in materials and workmanship (unless furnished by OWNER) for a period of one year from and after Final Acceptance under this Contract regardless of whether the same were furnished or performed by the CONTRACTOR or by any of its subcontractors or vendors of any tier. Upon receipt of written notice from OWNER of any defect in any such equipment, materials or labor during the applicable warranty period due to defective materials or workmanship, the affected item or parts thereof shall be repaired or replaced by CONTRACTOR at a time acceptable to OWNER.

13.1.2 CONTRACTOR shall perform such tests as OWNER may require to verify that such repairs and replacements comply with the requirements of this Contract. All costs incidental to such repair, replacement and testing, including the value of any OWNER-furnished materials spoiled by the CONTRACTOR'S failure to comply with the specifications set out in this Agreement, and the removal, replacement and reinstallation of equipment and materials necessary

to gain access shall be borne by CONTRACTOR. CONTRACTOR warrants such repaired or replaced work against defective materials and workmanship for a period of one year from and after acceptance thereof. Should CONTRACTOR fail to promptly make the necessary repair, replacement and tests, OWNER may perform or cause to be performed the same at CONTRACTOR'S expense. CONTRACTOR and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties as set forth herein.

2.12 ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

- A. Paragraph 14.1 of the General Conditions: delete in its entirety.
- B. Paragraph 14.2 of the General Conditions: add new subparagraph as follows:
 - 14.2.1 With each Application for Payment, CONTRACTOR shall submit to ARCHITECT/ENGINEER (a) an itemized Application for Payment based on Document 00405 - Schedule of Unit Price Work items and reflecting any retainage as may be specified in the Project Manual; and (b) such other Documents as may be reasonably requested by ARCHITECT/ENGINEER.
- C. Paragraph 14.4 of the General Conditions: add new subparagraph as follows:
 - 14.4.1 CONTRACTOR shall promptly pay each Subcontractor upon receipt of payment from OWNER out of the amount paid to CONTRACTOR on account of such Subcontractor's Work, the amount Subcontractor is entitled, reflecting the percentage actually retained from payments to CONTRACTOR on account of Subcontractor's Work. CONTRACTOR shall obtain Waiver of Liens from Subcontractor for such payment. CONTRACTOR shall, by an appropriate agreement with Subcontractor, require Subcontractor to make payments to their subcontractors in similar manner.
- D. Paragraph 14.7 of the General Conditions: add three new paragraphs as follows:
 - 14.7.9 third party claims filed or evidence indicating probable filing of such claims.
 - 14.7.10 failure of CONTRACTOR to make payments properly or promptly to Subcontractors for material, labor, or equipment.
 - 14.7.11 damage to OWNER or others.
- E. Paragraph 14.8 of the General Conditions: add new subparagraph as follows:

14.8.1 CONTRACTOR'S request for issuance of a Certificate of Substantial Completion shall include guarantees, bonds, certificates of inspection, waivers of lien, marked-up record documents and other documents as required by the Project Manual.

- F. Add the following at the end of Article 14: Liquidated Damages.

14.16 Should CONTRACTOR or Surety fail to complete the Work within such extra time as may be allowed by extensions, there shall be deducted from any monies due, or that may become due CONTRACTOR or Surety, the same set forth in the Agreement for each calendar day, including Sundays and holidays, that the Work shall remain uncompleted. This sum shall be the amount of \$2,000 per calendar day and shall be considered liquidated damages due the OWNER from CONTRACTOR or Surety because of OWNER'S loss of income and other costs incurred resulting from the failure to complete the Work within the time specified. Permitting CONTRACTOR or Surety to continue and finish the Work, or any part of it, after the time fixed for its completion may have been extended, shall in no way operate as a waiver on the part of OWNER of its rights under the Contract.

2.13 ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

- A. Paragraph 15.1 of the General Conditions, first sentence: delete the words "which will fix the date on which the Work will be resumed."
- B. Paragraph 15.1 of the General Conditions: add a new sentence immediately following the first sentence as follows:

Within 45 calendar days after such notice of suspension, OWNER shall give written notice to CONTRACTOR and ARCHITECT/ENGINEER of the date on which Work will be resumed.

- C. Paragraph 15.2 of the General Conditions: add six new paragraphs as follows:

15.2.5 if CONTRACTOR fails to make prompt payment to Subcontractors or for materials or labor; or

15.2.6 if CONTRACTOR abandons the Work; or

15.2.7 if CONTRACTOR sublets the Work without the previous written consent of the OWNER; or

15.2.8 if CONTRACTOR assigns this Agreement, or any claim thereunder, without the previous written consent of OWNER; or

15.2.9 if CONTRACTOR fails to achieve Substantial Completion within the Contract Time; or

15.2.10 if CONTRACTOR fails to make diligent and timely progress toward Substantial Completion.

2.14 ARTICLE 17 - MISCELLANEOUS

Paragraph 17.1 of the General Conditions: delete in its entirety and replace with the following:

17.1 Whenever any provision of the Project Manual requires the giving of written notice or the delivery of any Bond, Agreement, Certificate of Insurance, or any other item, it shall be deemed to have been validly delivered if given in person to the individual, to a member of the firm, or to an officer of the corporation for whom it is intended, or if given at or sent by registered or certified mail (return receipt), postage prepaid, to the last business address known to the individual who delivers the article.

PART 3 – ADDITIONS TO GENERAL CONDITIONS

3.01 ASSIGNMENT OF ANTITRUST ACTIONS TO OWNER

A. In accordance with Section 451 of the Government Code, the CONTRACTOR and subcontractors shall conform to the following requirements. In entering into a public works contract or a subcontract to supply goods, services, or materials pursuant to a public works contract, the CONTRACTOR or subcontractor offers and agrees to assign to the OWNER all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2 commencing with Section 16700 of Part 2 of Division 7 of the Business and Professional Code), arising from purchases of goods, services, or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the OWNER tenders final payment to the CONTRACTOR, without further acknowledgment by the parties. See also Section 4552 for further related requirements for those who submit bids.

3.02 SUBSTITUTION OF SECURITIES IN LIEU OF RETAINAGE

A. The CONTRACTOR may elect to receive 100 percent of payments due under the Project Manual, from time to time, without retention from any portion of the payment by the OWNER by depositing securities of equivalent value with the OWNER in accordance with the provisions of Section 22300 of the California Public Contract Code. Such securities, if deposited by the CONTRACTOR, shall be valued by the OWNER whose decision on the valuation under this section shall

be final. Securities eligible for investment under this shall be limited to those listed in Section 22300 of the California Public Contract Code and Section 16430 of the California Government Code.

3.03 TRAVEL AND SUBSISTENCE PAYMENTS

- A. As required by Section 1773.8 of the California Labor Code, the CONTRACTOR shall pay travel and subsistence payments to each worker needed to execute the Work as such travel and subsistence payments are defined in the applicable collective bargaining agreements filed in accordance with this Section.

3.04 PREVAILING WAGE RATES

- A. As required by Section 1770 et. seq. of the California Labor Code, the CONTRACTOR shall pay not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations. Copies of such prevailing rate per diem wages are on file at the office of the OWNER, which shall be made available to any interested party on request. The CONTRACTOR shall post a copy of such determination at each job site.
- B. As provided in Section 1775 of the California Labor Code, the CONTRACTOR shall, as a penalty to the OWNER, forfeit \$50.00 for each calendar day, or portion thereof, for each worker paid less than the prevailing rates as determined by the Director for such work under the contract by it or by any subcontractor under it.

3.05 RETENTION AND INSPECTION OF PAYROLL RECORDS

- A. As required under the provision of Section 1776 of the California Labor Code, each CONTRACTOR and subcontractor shall keep an accurate payroll record showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid by journeyman, apprentice, worker, or other employee employed by him or her in connection with the public work. The payroll records shall be certified and shall be available for inspection at all reasonable hours at the principal office of the CONTRACTOR under certain specified conditions.

3.06 WORKING HOURS

- A. The CONTRACTOR shall comply with all applicable provisions of Section 1810 and 1815 inclusive of the California Labor Code relating to working hours. The CONTRACTOR shall, as a penalty to the OWNER, forfeit \$25.00 for each worker employed in the execution of the Contract by the CONTRACTOR or by any subcontractor for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one (1) calendar day or forty

(40) hours in any one (1) calendar week, unless such workers receive compensation for all such hours worked in excess of eight (8) hours at no less than 1-1/2 times the basic rate of pay.

3.07 WORKER'S COMPENSATION

- A. In accordance with the provisions of Section 1860 of the California Labor Code, the CONTRACTOR's attention is directed to the requirement that, in accordance with the provisions of Section 3700 of the California Labor Code, every CONTRACTOR will be required to secure the payment of compensation of his or her employees.

- B. In accordance with the provisions of Section 1861 of the California Labor Code, each CONTRACTOR to whom a public works contract is awarded shall sign and file with the awarding body, the following certification prior to performing the work of the contract: "I am aware of the provisions of Section 3700 of the Labor Code which requires every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract."

END OF DOCUMENT

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Unit-cost allowances.
 - 2. Contingency allowances.

1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.

4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Contingency Allowance: Include allowance costs for possible conditions to sewer connection at Monterey Regional Management Pollution Control Agency (MRWPCA) / Waste Water Treatment Plant (WWTP). Current design shows route of sewer to a proposed connection within the existing MRWPCA/WWTP to the south of the proposed project. Unforeseen costs of connecting to the Recycle Sump No. 1 may occur as shown on Drawings.
1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.
- B. Allowance No. 2: Contingency Allowance: Include allowance costs for domestic water storage tank that will be connected to the proposed truck yard project. Allowance should include a hydro pneumatic tank or tanks to accommodate approximately 57,000 gallons of water storage. The location of said tank(s) would occur at the same

proposed location shown in the Drawings. Pumps and associated piping shall be included to produce an average supply of 45gpm for the duration of 12 hours.

1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.
- C. Allowance No. 3: Contingency Allowance: Include allowance costs for domestic water storage tank that will be connected to the entire MRWMD campus, not just for the proposed truck yard project. Allowance should include a hydro pneumatic tank or tanks to accommodate approximately 150,000 gallons of water storage. The location of said tank(s) would occur at the same proposed location shown in the Drawings. Tanks, pumps and associated piping shall be included to produce an average supply of 80gpm for the duration of 12 hours. This allowance would overwrite Allowance No. 2 in the event that MRWMD elects to pursue this option.
1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.
- D. Allowance No. 4: Contingency Allowance: Include allowance costs for 90,000 gallon non-potable water tank for use of fire suppression water storage. Location of tank is indicated on drawings. Tank, pump and associated piping shall be included to produce an average supply of 1,500 gpm at 20 psi for the duration of 2 hours.
1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.
- E. Allowance No. 5: Contingency Allowance: Include allowance costs for power receptacles to each proposed CNG slow fill station located in the truck parking areas. Each CNG station is proposed to have 2 slow fill stations each which would require two (2) power receptacles. Each power receptacle will be approximately 6kW of power, for a total load of about 300kW. The power to these locations is proposed to be supplied from the CNG transformer located in the CNG equipment area.
1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.

END OF SECTION 012100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1.

1. Base Bid: No roof walkway grating on Service Bay and Truck Wash buildings
2. Alternate: Provide walkway grating mounted to the metal roof panels without penetrations. Walkway grating shall use the S5 clips for mounting. Grating shall be factory painted to a color contrasting to that of the metal roof color. Color to be coordinated with Architect/Engineer prior to bid approvals.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A (which can be found at [CSI Form 13.1A](#)).
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.

- g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided for achieving LEED prerequisites and credits.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution provides sustainable design characteristics that specified product provided for achieving LEED prerequisites and credits.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500



SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)

Project: _____ Substitution Request Number: _____

 From: _____
 To: _____ Date: _____

 A/E Project Number: _____
 Re: _____ Contract For: _____

Specification Title: _____ Description: _____
 Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
 Manufacturer: _____ Phone: _____
 Address: _____
 Trade Name: _____ Model No.: _____
 Installer: _____ Phone: _____
 Address: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified product: _____

Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____
 Address: _____ Owner: _____
 _____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: No Yes [Add] [Deduct] _____ days.

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase — Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
 - Same warranty will be furnished for proposed substitution as for specified product.
 - Same maintenance service and source of replacement parts, as applicable, is available.
 - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
 - Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
 - Proposed substitution does not affect dimensions and functional clearances.
 - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
 - Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
-

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments:

A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: Contractor Subcontractor Supplier Manufacturer A/E
 Other:

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 2. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 4. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals unless approved by Architect and by signing of CADD Release Form prior to issuance.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect or Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or other electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.

- e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
- a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations: Identify deviations from the Contract Documents on submittals.
- G. Resubmittals: Make resubmittals in same form as initial submittal.
- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Submit electronic submittals via email as PDF electronic files.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
3. Action Submittals: Submit electronic copies of each submittal unless otherwise indicated. Architect, through Construction Manager, will return electronic response.
4. Informational Submittals: Submit electronic copies of each submittal unless otherwise indicated. Architect and Construction Manager will return electronic response.
5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.

- e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
- a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
- a. PDF electronic file.
 - b. Three paper copies of Product Data involving colors or other finishes unless otherwise indicated. Architect, through Construction Manager, will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
- a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings electronically unless colors or finishes are part of the approval process. In such cases submit on sheets at least 8-1/2 by 11 inches, but no larger than 24 x 36 inches.
3. Submit Shop Drawings in the following format:
- a. PDF electronic file, unless submittal involves colors or finishes.
 - b. Three opaque (bond) copies of each submittal. Architect, through Construction Manager, will return two copies.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check 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. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. 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 of 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 an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit three full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return two copies of submittal with options selected.
6. 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. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two. Sample sets; remainder will be returned.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 006550 "Application for Payment".
- G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in respective specification sections.
- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- I. LEED Submittals: Comply with requirements specified in Section 018113.13 "Sustainable Design Requirements - LEED for New Construction and Major Renovations,"
- J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

- Q. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- S. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."
- T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file copy of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

- A. General: Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and/or Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and/or Construction Manager will forward each submittal to appropriate party.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 2. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 3. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered[unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

**SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

- B. Related Requirements:
 - 1. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
 - 2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Facilitate recycling and salvage of materials.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. LEED Submittal: LEED letter template for Credit MR 2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

H. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

A. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:

1. Waste Management company to comply with CALGreen Section 5.408.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
1. Pulverize masonry to maximum 1-1/2-inch size.
 2. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- I. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- J. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Construction Manager's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit sustainable design submittals required in Section 018113.13 "Sustainable Design Requirements - LEED for New Construction and Major Renovations," Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings as deemed necessary by Owner.
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report and warranty.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.
- B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are

outside the limits of construction. Use CSI Form 14.1A (which is attached for reference).

1. Organize list of spaces in sequential order, starting with exterior areas first] [and] [proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect, through Construction Manager, will return annotated copy.
 - b. PDF electronic file. Architect, through Construction Manager, will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning

agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and

- other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
- l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- p. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700



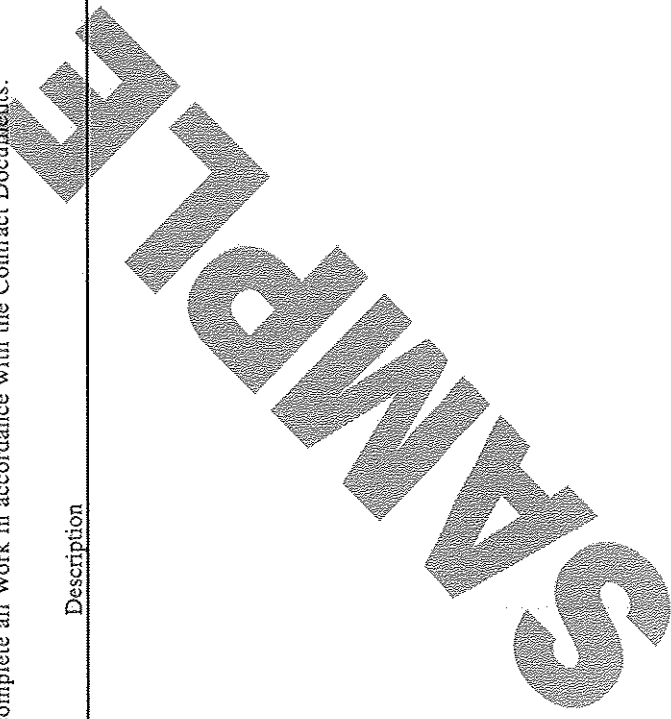
Knowledge for Creating
and Sustaining
the Built Environment

PUNCH LIST

Project: _____ From (A/E): _____
 Site Visit Date: _____
 To (Contractor): _____ A/E Project Number: _____
 Contract For: _____

The following items require the attention of the Contractor for completion or correction. This list may not be all-inclusive, and the failure to include any items on this list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Item Number	Room Number	Location (Area)	Description	Correction/Completion Date	Verification A/E Check
-------------	-------------	-----------------	-------------	----------------------------	------------------------



Attachments

Signed by: _____

Date: _____

Copies: Owner Consultants _____ _____ _____ _____ File

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.

2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit onepaper-copy set(s) of marked-up record prints.

2) Submit PDF electronic files of scanned record prints and **one** set(s) of file prints.

3) Submit record digital data files and one set(s) of plots.

4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned record prints and [one set of prints.

2) Print each drawing, whether or not changes and additional information were recorded.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it.
 - c. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

C.

2.2 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

END OF SECTION 017839

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Gold certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."
1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 3. A copy of the LEED Project scorecard is attached at the end of this Section for information only.
 4. Sample Material submittal form and VOC submittal form are attached at the end of this Section for information only.
 5. Specific requirements for LEED are also included in other Sections.

1.2 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their

role as end users of the product, which can no longer be used for its intended purpose.

2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

1.4 ACTION SUBMITTALS

- A. LEED Documentation Submittals:
 1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over time.
 2. Credit MR 4: Product data and certification letter from product manufacturers indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material cost for each product having recycled content.
 3. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 4. Credit IEQ 3.1:
 - a. Construction indoor-air-quality management plan.
 - b. Product data for temporary filtration media.
 - c. Product data for filtration media used during occupancy.
 - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
 5. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
 6. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
 7. Credit IEQ 4.3: Product data for Flooring Systems

8. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.5 INFORMATIONAL SUBMITTALS

- A. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
 1. Furniture.
 2. Plumbing.
 3. Mechanical.
 4. Electrical.
 5. Specialty items such as elevators and equipment.
 6. Wood-based construction materials.
- B. LEED Action Plans: Provide preliminary submittals within 14 days of date established for commencement of the Work indicating how the following requirements will be met:
 1. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 2. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
- C. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 30 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.3 REGIONAL MATERIALS

- A. Credit MR 5: Not less than 30 percent of building materials (by cost) shall be regional materials.

2.4 LOW-EMITTING MATERIALS

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.

29. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
 30. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
 31. Other Adhesives: 250 g/L.
 32. Architectural Sealants: 250 g/L.
 33. Nonmembrane Roof Sealants: 300 g/L.
 34. Single-Ply Roof Membrane Sealants: 450 g/L.
 35. Other Sealants: 420 g/L.
 36. Sealant Primers for Nonporous Substrates: 250 g/L.
 37. Sealant Primers for Porous Substrates: 775 g/L.
 38. Modified Bituminous Sealant Primers: 500 g/L.
 39. Other Sealant Primers: 750 g/L.
- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Flat Paints and Coatings: VOC not more than 50 g/L.
 2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
 3. Dry-Fog Coatings: VOC not more than 400 g/L.
 4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
 7. Pretreatment Wash Primers: VOC not more than 420 g/L.
 8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 10. Floor Coatings: VOC not more than 100 g/L.
 11. Shellacs, Clear: VOC not more than 730 g/L.
 12. Shellacs, Pigmented: VOC not more than 550 g/L.
 13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.3: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.
- D. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

PART 3 - EXECUTION

- 3.1 **[REFRIGERANT] [AND] [CLEAN-AGENT FIRE-EXTINGUISHING-AGENT] REMOVAL**
- A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in HVAC Sections.
 - B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See

Section 212200 "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

3.2 MEASUREMENT AND VERIFICATION

- A. Credit EA 5: Implement measurement and verification plan consistent with Option B: Energy Conservation Measure Isolation Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction"
- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
- D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - 2. Replace all air filters immediately prior to occupancy.
- B. Credit IEQ 3.2: Comply with one of the following requirements:
 - 1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
 - 2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in Prerequisite IEQ 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

3. Air-Quality Testing:
- a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."
 - b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
 - 1) Formaldehyde: 27 ppb.
 - 2) Particulates (PM10): 50 micrograms/cu. m.
 - 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
 - 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
 - 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
 - c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
 - d. Air-sample testing shall be conducted as follows:
 - 1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
 - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
 - 3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
 - 4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 018113.13

Certified* 40 to 49 points Silver* 50 to 59 points Gold* 60 to 79 points Platinum* 80 or more points

8 3 15 Sustainable Sites		Possible Points 26	
Y	? N	7	Materials & Resources
Y		1	Prereq 1 Construction Activity Pollution Prevention
1		5	Credit 1 Site Selection
		1	Credit 2 Development Density & Community Connectivity
		1	Credit 3 Brownfield Redevelopment
		6	Credit 4.1 Alternative Transportation, Public Transportation Access
1		1	Credit 4.2 Alternative Transportation, Bicycle Storage & Changing Rooms
3		3	Credit 4.3 Alternative Transportation, Low Emitting & Fuel Efficient Vehicles
		2	Credit 4.4 Alternative Transportation, Parking Capacity
		1	Credit 5.1 Reduced Site Disturbance, Protect or Restore Open Space
		1	Credit 5.2 Reduced Site Disturbance, Maximize Open Space
		1	Credit 6.1 Stormwater Management, Quantity Control
1		1	Credit 6.2 Stormwater Management, Quality Control
		1	Credit 7.1 Landscape & Exterior Design to Reduce Heat Islands, Non-Roof
1		1	Credit 7.2 Landscape & Exterior Design to Reduce Heat Islands, Roof
1		1	Credit 8 Light Pollution Reduction

4 5 Water Efficiency		Possible Points 10	
Y	? N	9	Indoor Environmental Quality
Y		1	Prereq 1 Minimum IEQ Performance
2		1	Prereq 2 Environmental Tobacco Smoke (ETS) Control
		2	Credit 1 Water Use Reduction
		2	Credit 2 Water Efficient Landscaping, No Potable Use or No Irrigation
		2	Credit 3 Innovative Wastewater Technologies
		2	Credit 3.1 Water Use Reduction, 30% Reduction
		1	Credit 3.2 Water Use Reduction, 35% Reduction
		1	Credit 3.3 Water Use Reduction, 40% Reduction

10 26 4 Energy & Atmosphere		Possible Points 35	
Y	? N	3	Innovation & Design Process
Y		8	Prereq 1 Fundamental Commissioning of the Building Energy Systems
Y		7	Prereq 2 Minimum Energy Performance
Y		2	Prereq 3 Fundamental Refrigerant Management
		19	Credit 1.1-1.10 Optimize Energy Performance, 12% - 48% (Goal to achieve Gold = 40%)
		7	Credit 2.1 On-Site Renewable Energy, 1% / 3% / 5% / 7% / 9% / 11% / 13%
2		2	Credit 3 Enhanced Commissioning
		2	Credit 4 Enhanced Refrigerant Management
		3	Credit 5 Measurement & Verification
		2	Credit 6 Green Power

1 2 1 Regional Credit		Possible Points 4	
Y	? N	3	Innovation & Design Process
Y		1	Credit 1.1 Innovation in Design: Regional Materials Content 30% or more of building (by cost)
		1	Credit 1.2 Innovation in Design: Recycled Content 30% or more of building (by cost)
		1	Credit 1.3 Innovation in Design: Exemplary 95% Diversion from Landfill
		1	Credit 1.4 Innovation in Design: Green Cleaning
		1	Credit 1.5 Innovation in Design: Reduction of CO2
		1	Credit 2 LEED™ Accredited Professional

* LEED Credit Submissions are subject to final approval by the GBCI

Materials Submittal Form

The project team are pursuing certification under the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System. To fulfill the requirements of this program, **this form must be completed for each product that will be furnished for the project** other than wet applied products – please refer to the VOC Submittal form.

Please completely fill out the information requested below. Write “**N/A**” for information that does not apply.

Sub Contractor: _____	Spec Section: _____
Contact: _____	Date: _____
Material Name: _____	Manufacturer: _____
Material Costs (not including equipment and labor): \$ _____	
Material Source Location:	
Location of Manufacture*:	_____ City/State
	_____ Miles from project site
Location of Harvest/Extraction**:	_____ City/State
	_____ Miles from project site
<input type="checkbox"/> have attached manufacturer documentation stating the location of the harvest/extraction.	
Recycled Content¹:	
% Post Consumer	_____ %
<i>Combined total cannot equal > 100%</i>	
% Post-Industrial:	_____ %
<input type="checkbox"/> have attached manufacturer documentation stating the percentage of recycled content.	
Rapidly Renewable Materials: _____ % of Material \$	
<input type="checkbox"/> have attached manufacturer documentation stating the percentage of rapidly renewable content.	
FSC Certified Wood Material:	
Chain-of-Custody Certificate # _____	
	_____ % of Material \$
<input type="checkbox"/> I have attached manufacturer documentation stating the percentage of rapidly renewable content.	
Signature: _____	Date: _____

* Manufacturing refers to the final assembly of components into a building product. For example, the location of manufacturing for structural steel would be the address of the fabrication shop (not the steel mill).

** Location of Harvest refers to where it is extracted from the ground. For example, the location of drywall harvest is the gypsum mine. If it is recycled gypsum the Location of Harvest would be the recycling plant.

¹ Post-Consumer content is from previous use (bottles, cards) and Post-Industrial content is recaptured from the industrial process (fly ash, metal trimmings). If not specified, assume Post-Industrial.

VOC Submittal Form

The project team are pursuing certification under the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System. A major goal of this program is to reduce the quantity of indoor air contaminants that are odorous and/or potentially harmful to the comfort and well-being of the installer or occupant. To fulfill the requirements of this program, **this form must be completed for each product that will be wet applied products inside the building's weather proofing system.**

All products must be compliant with the **Volatile Organic Compound**. Please provide a copy of the Material and Safety and Data Sheets (MSDS) with the VOC submittal form. The MSDS must state the VOC content in **grams per liter**. If this information is not included in the MSDS, please request the VOC content (in grams/liter) from the manufacturer. **Do not assume a zero VOC content if the information is not shown.**

Please completely fill out the chart below:

Sub Contractor: _____ **Spec Section:** _____

Contact: _____ **Date:** _____

I plan on using the following VOC containing Adhesives, Sealants, Primers and /or Paint on the interior* of the project.

Product Name: (manufacturer and product ID)	Type of Product: (adhesive, sealant, paint)	This product is used for: (application description)	VOC Content in g/L (attach MSDS Sheet with VOC content)	Allowable Content in g/L

I have attached a copy of the MSDS stating the VOC content for each product listed in the chart above.

By signing below, I hereby certify that these are the only VOC products that I will use on the interior of the building.

Signature: _____ Date: _____

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Section 230800 "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.

1.3 DEFINITIONS

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

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to

implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 EACH CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 3. Attend commissioning team meetings held on a variable basis.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review and accept construction checklists provided by the CxA.
 6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 019113

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Predemolition Photographs or Video: Submit before Work begins.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated 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.
 - 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 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.
 - 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.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. 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.
 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and 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.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. 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, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. 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 containers.
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 item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, 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.

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.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 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 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MR 5: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 - 3. Product Data for Credit IEQ 4.3: For curing and sealing compounds used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Design Mixtures: For each concrete mixture.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans; subject to compliance with requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.
- C. Material test reports.
- D. Floor surface flatness and levelness measurements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
 - 2. ACI 302.1R "Guide for Concrete Floor and Slab Construction."
 - 3. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 4. ACI 306.1, "Standard Specification for Cold Weather Concreting."
 - 5. ACI 308.1, "Standard Specification for Curing Concrete."
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than [25]percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II/V, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

1. Products.

- a. Euclid Chemical Company (The); Air Mix or AEA-92 Series.
- b. Grace Construction Products; Darex or Daravair series.
- c. BASF; MB-VR or MB-AE.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

- a. Euclid Chemical Company (The); Eucon Series.
- b. BASF; Pozzoloth Series.
- c. WR Grace; WRDA Hycol.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

- a. Euclid Chemical Company (The); Eucon Retarder Series.
- b. BASF; Pozzoloth Series.
- c. WR Grace; Daratard Series.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

- a. Euclid Chemical Company (The); Eucon Retarder Series.
- b. BASF; Pozzoloth Series.
- c. WR Grace; Daratard Series.

4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

- a. Euclid Chemical Company (The); Eucon 37 or Plastol Series.
- b. BASF; Rheobuild 1000 or Glenium Series.
- c. WR Grace; Daracem or Adva Series.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

- a. Euclid Chemical Company (The); Eucon 537 or Plastol Series.
- b. BASF; Glenium Series.
- c. WR Grace; Daracem or Adva Series.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- a. Euclid Chemical Company (The); Eucon 537.
- b. BASF; Rheobuild Series.
- c. WR Grace; Daracem Series.

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash and/or pozzolan, as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 15 percent. Refer to Concrete structural notes on drawings for additional information.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

D. Proportion normal-weight concrete mixture as follows:

1. Refer to Concrete structural notes on drawings for additional information.

E. Proportion structural lightweight concrete mixture as follows:

1. Refer to Concrete structural notes on drawings for additional information.

2.8 FABRICATING REINFORCEMENT

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

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Refer to Contract Drawings for contraction joint depth. Construct contraction joints as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated on the Contract Drawings.
- E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- D. Cold-Weather Placement: Comply with ACI 306.1.
- E. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, and/or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply finishing material of a consistency of thick paint to coat surfaces and fill small holes. Add gray and white finishing material together in amounts determined by trial patches so color of dry finishing material will match adjacent surfaces. Scrub finishing material into voids and remove excess finishing material. When finishing material whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply finishing material. Add gray and white finishing material together in amounts determined by trial patches so color of dry finishing material will match adjacent surfaces. Compress finishing material into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces indicated on design documents and to receive concrete floor toppings, and/or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated to be exposed to view and/or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface flatness and levelness using the F-number system per ACI 302.1R. Refer to Concrete structural notes on drawings for additional information.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller at the application rate at which it meets ASTM C309 according to manufacturer's written instructions. If sprayed, backroll with short nap roller. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller at the application rate at which it meets ASTM C309 according to manufacturer's written instructions. If sprayed, backroll with short nap roller. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 033000

033000-1 DIAMOND DOWEL® SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Products supplied under this section: diamond shaped load plates.
- B. Related sections:
 - 1. Section 03300 - Cast-in-place concrete.

1.2 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI Detailing Manual SP-66.
 - 2. ACI 302.1R-04 Guide for Concrete Floor and Slab Construction.
 - 3. ACI 360R-10 Guide for Design of Slabs-on-Ground.
- B. American Society for Testing and Materials International (ASTM):
 - 1. A 36 Standard Specifications for Carbon Structural Steel.
 - 2. A 108 Standard Specifications for Steel Bar, Carbon and Alloy, Cold Finished.

1.3 SUBMITTALS

- A. Product data: Manufacturer's product data with application and installation instructions for proprietary materials and items, including but not limited to the Diamond Dowel® System.
- B. Shop drawings: Indicate placement of the Diamond Dowel® System.
 - 1. Indicate dimensions and spacings.
 - 2. Comply with ACI 302.1R-04, ACI 360R-10, ACI Detailing Manual (SP-66) and PNA installation guides indicating arrangement of dowels.

1.4 QUALITY ASSURANCE

- A. Pre-installation meeting:
 - 1. Convene a pre-installation meeting 2 weeks before installation of PNA products. Require attendance of parties affecting the work of this section, including Contractor, Engineer, and installers.
 - 2. Review installation procedures and coordinate with other work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver Diamond Dowel® System in manufacturer's packaging.
- B. Deliver and handle materials to prevent damage or weakening to systems.
- C. Prevent accumulation of rust, debris or deleterious materials on systems during storing. Store off ground and under cover.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acceptable manufacturer: PNA Construction Technologies, www.pna-inc.com; 800-542-0214.

2.2 DIAMOND SHAPED LOAD PLATE FOR CONSTRUCTION JOINTS

- A. Acceptable product: PNA Diamond Dowel® System.
- B. Material:
 - 1. Diamond shaped load plate: 1/4" and 3/8" saw cut from hot rolled steel plate meeting ASTM A 36. 3/4" saw cut from cold rolled steel plate for acceptable tolerances meeting ASTM 108-03 grade 1018.
 - 2. Pocket former: High density plastic with internal collapsible fins and spacer that hold diamond shaped load plate in correct position and creates a void to its vertical faces. This void, in addition to its tapered shape, shall allow for differential movement and shall prevent horizontal stress accumulation at joint, thus reducing likelihood of random cracking.

REFER TO ACI 302.1R-04 FOR SELECTION OF PLATE SIZE AND SPACING.

- 3. Dimensions of plate: 1/4" by 4-1/2" by 4-1/2". 3/8" by 4-1/2" by 4-1/2". 3/4" by 4-1/2" by 4-1/2". (Refer to the structural drawings for additional information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Notify Engineer at least 72 hours prior to placing concrete dowel system to allow time for examination of systems. Place no concrete in forms without Engineer's acceptance of concrete dowel systems.

3.2 INSTALLATION

- A. Install at formed construction joints.
- B. Mark center point for spacing of each Diamond Dowel® pocket former on top of wood form along entire length. Set forms along construction joints. Place Diamond Dowel® System up to within 6" of joint intersection per industry guidelines. Installation template will ensure that the minimum requirement of 2 1/4" of coverage of concrete over the dowel is maintained.
- C. Use installation template. Insert correct tube, if needed, based on slab depth. Use orange template with 1/4". Use yellow template with 3/8". Use green template with 3/4".
 - 1. Orange 1/4":
 - a. 7" slab depth: Remove tube from template.
 - b. 6" slab depth: Slide white tube onto template.
 - c. 5" slab depth: Slide black tube onto template.
 - d. 4" slab depth: Slide grey tube onto template.

2. Yellow 3/8":
 - a. 9" slab depth: Remove tube from template.
 - b. 8" slab depth: Slide white tube onto template.
 - c. 7" slab depth: Slide black tube onto template.
 3. Green 3/4":
 - a. 11" slab depth: Remove tube from template.
 - b. 10" slab depth: Slide white tube onto template.
 - c. 9" slab depth: Slide black tube onto template.
- D. Insert Diamond Dowel® pocket former into installation template.
 - E. Line up mark on top of wood form with center of template.
 - F. Nail Diamond Dowel® pocket former and remove installation template. Repeat at specified spacing along entire length of form.
 - G. Place and finish first slab. Use internal vibration to consolidate concrete around diamond shaped load plate pocket former per industry guidelines.
 - H. Strip forms and bend nails flush with joint face.
 - I. Insert Diamond Dowel® load plate into slot created by pocket former. Center corner of plate in middle of label and push straight through label into pocket former. Do not hammer or use excessive force to insert diamond shaped load plate. Insert diamond shaped load plate within two weeks of concrete placement.
 - J. Place and finish second slab. Use internal vibration to consolidate concrete around Diamond Dowel® plate per industry guidelines.

3.4 PROTECTION:

- A. Protect the Diamond Dowel® System from displacement and from damage until concrete placement is complete.

END OF SECTION

033000-2 CONCRETE REPAIR SPECIFICATIONS

PART 1 - GENERAL

1.1. Work Included

- A. Furnish all materials, labor, tools, and equipment to repair or replace concrete as shown on drawings.

1.2. Reference Documents

- A. ICRI Guideline 310.2 (formerly # 03732) "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays".
- B. ICRI Guideline 310.1R (formerly # 03730) "Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion".

1.3. Submittals

- A. Submit literature and manufacturer's written installation recommendations prior to the start Work.
- B. Material Safety Data Sheets.
- C. Submit list and contact information for 5 projects of similar size and scope completed in the prior 5 years.

1.4. Quality Assurance

- A. Manufacturer qualifications
 - 1. Product manufacturer shall have ISO 9001 Quality Certification and experience in the production of specified products.
- B. Contractor Qualifications
 - 1. Applicator shall have minimum 5 years prior experience with the use and application of the specified materials or similar products and shall have completed 5 jobs of similar size and scope in the prior 5 years.

1.5. Delivery, Storage, and Handling

- A. Deliver specified products in original, unopened containers with manufacturer's name, labels, product identification, and batch numbers intact.
- B. Store and condition the specified products per manufacturer's written recommendations.

1.6. Job Conditions

- A. Refer to manufacturer's data sheet for recommended temperature of surfaces to be repaired and ambient air temperature during application and curing times.
- B. Do not apply material if substrate is frozen or if freezing conditions are imminent.
- C. Mask off adjoining surfaces not to receive repair material to prevent damage to surfaces outside area to be repaired.
- D. Protect repaired surfaces from traffic, damage, and contamination.

1.7. Pre-Repair Conference

- A. Prior to start of repairs Contractor shall conduct a meeting to review the required methods and procedures to achieve the required repair. Contractor shall send a conference agenda to all attendees 20 days prior to the scheduled date of the conference. The contractor shall require responsible representatives of every party concerned with the repair work to attend the conference, including but not limited to the following:
 - 1. Contractor's superintendent
 - 2. Testing lab
 - 3. Admixture/repair material manufacturer
 - 4. Owner's Representative
 - 5. Specifier
- B. Minutes of the meeting shall be recorded, typed, and distributed by the Contractor to all concerned parties, including but not limited to Owner's representative, specifier, and all attendees within five days of the meeting.

1.8. Mock Up

- A. Contractor shall do mock ups of minimum 2' by 2' area for each type of repair and 2 lineal feet of cracks at the jobsite in inconspicuous areas where directed by specifier using procedures specified and manufacturer's written recommendations.
- B. Apply mock ups in area with similar lighting conditions using the same equipment and personnel as will be used for the Work.
- C. Specifier will view the mock ups and the Work will not proceed until they have been approved. Once approved use the same procedures for the Work. Mock ups may become part of the completed Work with specifier's written approval.

PART 2 - PRODUCT

2.1 Horizontal Repair Material:

A. Non-polymer modified cementitious mortar.

1. Acceptable Product: Eucocrete by The Euclid Chemical Company.

2.2 Vertical Repair Material:

A. Non-polymer modified cementitious mortar.

1. Acceptable Products: Eucocrete or Eucopatch by The Euclid Chemical Company.

2.3 Horizontal Polymer Modified Repair Material:

A. Polymer modified cementitious mortar.

1. Acceptable Product: Thin Coat or Tammspatch II by The Euclid Chemical Company.

2.4 Vertical Polymer Modified Repair Material:

A. Polymer modified cementitious mortar.

1. Acceptable Product: Verticoat Supreme by The Euclid Chemical Company.

2.5 Variable Shade Repair Mortar:

A. Repair Mortar that is available from the manufacturer in multiple concrete shades to more closely match the concrete being repaired.

1. Acceptable Products: Speed Crete Red Line (for vertical) or Tammspatch II (for horizontal) by The Euclid Chemical Company.

2.6 Finishing Material:

A. Finishing Material that is available from the manufacturer in multiple concrete shades to more closely match the concrete surface.

1. Acceptable Products: Tammscrete or Tamms Cement Wash by The Euclid Chemical Company.

2.7 Redispersable Bonding Agent:

A. Acrylic, ASTM C1059, Type I, Redispersable.

1. Acceptable Product: Tammsweld by The Euclid Chemical Company.

2.8 Non-Redispersable Bonding Agent:

A. Acrylic, ASTM C1059, Type II, Non-Redispersable.

1. Acceptable Products: Flex-Con or Akkro-7T by The Euclid Chemical Company.

2.9 Epoxy/Cementitious Bonding Agent:

A. Extended Open Time Bonding Agent: Three component, pre-proportioned, VOC compliant, water based, epoxy modified, portland cement bonding agent, that does not form a vapor barrier and contains a migratory corrosion inhibitor for use on concrete and steel. Bonding agent shall provide 24 hours of open time at 75 deg F and bond strength of 2,700 psi per ASTM C 882.

1. Acceptable Product: Duralprep A.C. by The Euclid Chemical Company.

2.10 Epoxy Adhesive and Crack Repair:

A. 100 percent solids, two component material suitable for use on dry or damp surfaces, VOC compliant, conforming to ASTM C881.

1. Acceptable Products: Duralcrete Epoxy System or Dural Fast Set Epoxy System by The Euclid Chemical Company.

2.11 Self-Leveling Underlayment:

A. Free flowing, self-leveling, pumpable cementitious base material.

1. Acceptable Products: Flo-Top, Super Flo-Top, or Tamms SLU by The Euclid Chemical Company.

2.12 Self-Leveling Topping:

A. Single component, cementitious, high strength self-leveling topping that can accept stain, densifier/hardeners, adhesive, or coatings within 24 hours.

1. Acceptable Products: EucoFloor 24 and EucoFloor Epoxy Primer by The Euclid Chemical Company.

2.13 Self-Generating Cathodic Protection:

A. Self-generating cathodic protection to mitigate the corrosion of steel in concrete and counteract the "anode ring effect".

1. Acceptable Product: Sentinel GL by The Euclid Chemical Company.

2.14 Removable Curing Compound:

A. Removable, VOC compliant curing compound meeting ASTM C 309 Type 1, Class A& B. Specifically designed to be easily removed by the application of a cleaner/remover

for slabs that will receive sealers, densifiers, coatings, or adhesives. For interior use only since wetting will make it difficult to remove.

1. Acceptable Products:

- a. Removable Curing Compound: Kurez RC-100 by The Euclid Chemical Company.
- b. Cleaner/Remover: Kurez RC-off by The Euclid Chemical Company.

2.15 Curing/Sealing Compound

- A. VOC compliant, acrylic curing/sealing compound complying with ASTM C 1315, Type 1, Class A.

1. Acceptable Product: Super Diamond Clear VOX by The Euclid Chemical Company.

2.16 Admixture

- A. Shrinkage Reducing Admixture (SRA): Liquid admixture specifically designed to reduce drying shrinkage and the potential for cracking.

1. Acceptable Product: Eucon SRA Floor by The Euclid Chemical Company.

2.17 Integral Color

- A. Pigments for integrally colored concrete shall be pre-weighed, pre-packaged, high-grade dry or liquid coloring pigment complying with ASTM C979.

1. Acceptable Product: Color-Crete by Increte Systems, a division of The Euclid Chemical Company.
2. Color to be selected by specifier from manufacturer's standard colors.

2.18 Joint Filler

- A. Two component, semi-rigid, USDA approved, polyurea joint filler with elongation per ASTM D 412 of 200-250 % and Shore A hardness per ASTM D 2240 of 88-90.

1. Acceptable Product: Euco QWIKjoint 200 by The Euclid Chemical Company.
2. Color to be selected by specifier from manufacturer's standard colors.

2.19 Concrete Mixes

- A. Concrete shall have maximum shrinkage of 0.02% per ASTM C157 at 28 days.

2.20 Manufacturer

- A. Manufacturer shall have ISO 9001 Quality Certification. To ensure compatibility all products shall be from the same manufacturer.

PART 3 - EXECUTION

3.1 Specifier Approval Prior to Commencing Work

- A. Do not begin any repair work without specifier's approval and without approval of the mock up.

3.2 Surface Preparation

A. Spalls and Partial Depth

1. Prepare surface per ICRI Guideline 310.1R.
2. Sawcut boundaries of unsound concrete to 3/8" minimum depth. Sawcuts shall be perpendicular to concrete surface and concrete removal boundaries shall be straight and aligned parallel to opposite boundary edges resulting in rectangular repair areas.
3. Remove concrete from within repair boundaries to minimum depth of 3/8".
4. Concrete shall be structurally sound with delaminated and cracked concrete removed and shall be free from oil, efflorescence, laitance, paint and other contaminants that could inhibit bond.
5. Blow clean using un-oiled air or vacuum clean to remove deteriorated concrete, dust, dirt, debris, and anything else that could inhibit bond.
6. Surface shall be the CSP (Concrete Surface Profile) value per ICRI Guideline 310.2 as written on the manufacturer's data sheet.
7. Surface shall be clean, sound and SSD (Saturated Surface Dry) for the application of cementitious materials.
8. Surface shall be clean, sound and dry for the application of epoxy materials.

B. Full Depth

1. Sawcut concrete as indicated on drawings without damaging rebars or welded wire fabric.
2. Remove concrete to full depth.
3. Dowel new concrete into existing concrete as indicated on drawings.
4. Concrete shall be structurally sound with delaminated and cracked concrete removed and shall be free from oil, efflorescence, laitance, paint and other contaminants that could inhibit bond.
5. Blow clean using un-oiled air or vacuum clean to remove deteriorated concrete, dust, dirt, debris, and anything else that could inhibit bond.

C. Cracks

1. Remove dirt, dust, debris, oil, grease, paint, curing compounds, sealers, residue and other materials that may act as a bond breaker from joints and joint edges.
2. Blow clean using un-oiled air or vacuum.
3. Concrete shall be clean, dry and sound.

3.3 Repair Materials

- A. Mix, apply and cure materials per manufacturer's written recommendations.

1. Use Horizontal Repair Material for structural horizontal applications.
2. Use Vertical Repair Material for structural vertical and overhead applications.
3. Use Horizontal Polymer Modified Repair Material for non-structural horizontal applications.
4. Use Vertical Polymer Modified Repair Material for non-structural vertical and overhead applications.
5. Use Variable Shade Repair Mortar for exposed concrete to more closely match the color of the concrete being repaired.
6. Use Finishing Material for vertical exposed concrete to fill in small holes and voids and to repair surface defects and imperfections.
7. Use Redispersible Bonding Agent for indoor applications, not subject to moisture.
8. Use Non-Redispersible Bonding Agent for outdoor applications and applications subject to moisture.
9. Use Epoxy/Cementitious Bonding Agent where long open time or the protection of the rebars from corrosion is required.
10. Use Epoxy Adhesive and Crack Repair for applications requiring a concrete to concrete or a concrete to steel bond and for the repair of cracks.
11. Use Self-Leveling Underlayment for indoor applications, not subject to moisture and not subject to wear.
12. Use Self-Leveling Topping for outdoor applications, applications subject to moisture, applications subject to wear, and applications that need to be stained, polished, adhered to, or coated with 24 hours.
13. Use Removable Curing Compound for indoor repairs that need to be cured but that cannot have a bond breaker or sealed surface.
14. Use Curing/Sealing Compound on cementitious repairs that require curing and sealing.
15. Use Admixture in new concrete to achieve maximum 0.02% shrinkage per ASTM C157 at 28 days.
16. Use Integral Color as required when the color of the repair needs to more closely match the color of the surrounding concrete.
17. Use joint filler to fill joints after repairs have been completed.
18. Use Self-Generating Cathodic Protection in repairs where there has been corrosion of embedded steel.

3.4 Cleaning

- A. Leave finished work and work area in neat, clean condition without evidence of spillovers onto adjacent areas or walls.

3.5 Protection

- A. Protect Work from damage as from other trades.

END OF SECTION

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Steel reinforcing bars.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit MR 5: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and

fraction by weight of each regionally manufactured material that is regionally extracted.

- C. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- D. Samples: For each type and color of exposed masonry unit and colored mortar.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties and material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample panels for each type of exposed unit masonry construction exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Design Basis: ORCO Block for color range depicted on Drawings.

2.2 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 2. Density Classification: Medium weight.

2.3 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout.

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
 - 1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Capital Materials Corporation; Flamingo Color Masonry Cement.
- b. Cemex S.A.B. de C.V.; [Brikset Type N] [Citadel Type S] [Dixie Type S] [Kosmortar Type N] [Richmortar] [Victor Plastic Cement].
- c. Essroc, Italcementi Group; [Brixment] [or] [Velvet].
- d. Holcim (US) Inc.; [Mortamix Masonry Cement] [Rainbow Mortamix Custom Buff Masonry Cement] [White Mortamix Masonry Cement].
- e. Lafarge North America Inc.; [Magnolia Masonry Cement] [Lafarge Masonry Cement] [Trinity White Masonry Cement].
- f. Lehigh Cement Company; [Lehigh Masonry Cement] [Lehigh White Masonry Cement].
- g. National Cement Company, Inc.; Coosa Masonry Cement.

F. Mortar Cement: ASTM C 1329.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. Lafarge North America Inc.; [Lafarge Mortar Cement] [or] [Magnolia Superbond Mortar Cement].

G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar; Architect to select color from full range of manufacturers colors.

1. **Products:** Subject to compliance with requirements, **provide one of the following:**
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors, Inc.; SGS Mortar Colors.

2. Colored Masonry Cement:

- a. **Products:** Subject to compliance with requirements, provide one of the following: (Color as indicated on drawings)
 - 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
 - 3) Essroc, Italcementi Group; Brixment-in-Color.
 - 4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
 - 6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 7) National Cement Company, Inc.; Coosa Masonry Cement.

H. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.

3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
 - J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Euclid Chemical Company (The);** Accelguard 80.
 - b. **Grace Construction Products, W. R. Grace & Co. - Conn.;** Morset.
 - c. **Sonneborn Products, BASF Aktiengesellschaft;** Trimix-NCA.
 - K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer. Products shall be compatible with exterior applied water repellent in Section 071900
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **ACM Chemistries, Inc.;** RainBloc for Mortar.
 - b. **BASF Aktiengesellschaft;** Rheopel Mortar Admixture.
 - c. **Grace Construction Products, W. R. Grace & Co. - Conn.;** Dry-Block Mortar Admixture.
 - L. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" Section 076200 "Sheet Metal Flashing and Trim and as follows:
 1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
- B. Flexible Flashing: Use one of the following unless otherwise indicated:
 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-

laminated polyethylene film to produce an overall thickness of not less than 0.030 inch .

a. **Products:** Subject to compliance with requirements, provide one of the following:

- 1) **Advanced Building Products Inc.;** Peel-N-Seal.
- 2) **Carlisle Coatings & Waterproofing;** CCW-705-TWF Thru-Wall Flashing.
- 3) **Dayton Superior Corporation, Dur-O-Wal Division;** Dur-O-Barrier Thru-Wall Flashing.
- 4) **Fiberweb, Clark Hammerbeam Corp.;** Aquaflash 500.
- 5) **Grace Construction Products, W. R. Grace & Co. - Conn.;** Perm-A-Barrier Wall Flashing.
- 6) **Heckmann Building Products Inc.;** No. 82 Rubberized-Asphalt Thru-Wall Flashing.
- 7) **Hohmann & Barnard, Inc.;** Textroflash.
- 8) **W. R. Meadows, Inc.;** Air-Shield Thru-Wall Flashing.
- 9) **Polyguard Products, Inc.;** [**Polyguard 300**] [**Polyguard 400**].
- 10) **Sandell Manufacturing Co., Inc.;** Sando-Seal.
- 11) **Williams Products, Inc.;** Everlastic MF-40.

2. **Elastomeric Thermoplastic Flashing:** Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

a. **Products:** Subject to compliance with requirements, provide one of the following:

- 1) **DuPont;** Thru-Wall Flashing.
- 2) **Hohmann & Barnard, Inc.;** Flex-Flash.
- 3) **Hyload, Inc.;** Hyload Cloaked Flashing System.
- 4) **Mortar Net USA, Ltd.;** Total Flash.

C. **Single-Wythe CMU Flashing System:** System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. **Products:** Subject to compliance with requirements, provide one of the following:

a. **Mortar Net USA, Ltd.;** Blok-Flash.

D. **Solder and Sealants for Sheet Metal Flashings:** As specified in Section 076200 "Sheet Metal Flashing and Trim."

E. **Adhesives, Primers, and Seam Tapes for Flashings:** Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.8 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated on Concrete Masonry Units notes on the drawings.
 - 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated.
 - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 TOLERANCES

- A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in stacked bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.3 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- D. Refer to structural Masonry Details on drawings for additional information.

3.4 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Refer to structural Masonry Details on drawings for anchoring requirements.

3.5 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 - 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned

edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.6 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.7 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Refer to structural Concrete Masonry Notes on drawings for inspection.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.8 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.9 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Field-installed shear connectors.
 - 3. Grout.
- B. Related Requirements:
 - 1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
 - 2. Section 055000 "Metal Fabrications" for other steel items not defined as structural steel.
 - 3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content; include statement indicating cost for each product having recycled content
 - 2. Product Data for Credit MR 5: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 - 3. Product Data for Credit IEQ 4.2: For paints, coatings and primers used inside the weatherproofing system provide printed documentation of the products VOC content.
- C. 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.
 5. Identify members and connections of the Seismic-Load-Resisting System.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
- D. 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 qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, testing agency.
- 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. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
- F. Source quality-control reports.
- G. Field quality-control and special inspection] reports.

1.7 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, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) or City of Los Angeles Certified.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE or City of Los Angeles Certified
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- D. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
1. W-Shapes: 60 percent.
 2. Channels, Angles, M , S-Shapes: 60 percent.
 3. Plate and Bar: 25 percent.
 4. Cold-Formed Hollow Structural Sections: 25 percent.
 5. Steel Pipe: 25 percent.
 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: ASTM A 992/A 992M .
- C. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M .
- D. Plate and Bar: ASTM A 36/A 36M ASTM A 572/A 572M, Grade 50 .

- E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B , structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

2.2 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.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Headed Anchor Rods: ASTM F 1554, Grade 36 and ASTM F 1554, Grade 105, weldable , 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.
- E. Threaded Rods: ASTM A 36/A 36M and ASTM A 193/A 193M, Grade B7
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 3. Finish: Plain .

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the requirements of IEQ credit 4.2. testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 .

2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Mark and match-mark materials for field assembly.
 - 4. 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 2, "Hand Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.
- H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Types: Snug tightened, Pretensioned and/or Slip critical.
- 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. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
- B. 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.
 1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates : Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Types: Snug tightened, Pretensioned, and/or Slip critical.

- 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.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test and inspect field welds 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 are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

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. K-series steel joists.
- 2. Joist accessories.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
- 2. Section 042200 "Unit Masonry" for installing bearing plates in unit masonry.
- 3. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.

- B. LEED Submittals:

- 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- 2. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer certificates.
- B. Mill Certificates: For each type of bolt.
- C. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 1. As Indicated on Drawings.

- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists.
- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Do not camber joists.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- C. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- D. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated
- E. Welding Electrodes: Comply with AWS standards.
- F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 1. Space, adjust, and align joists accurately in location before permanently fastening.
 2. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

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. Roof deck.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 3. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
 - 4. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MR 5: For products and materials with requirements for regional materials indicating location and distance from Project to material manufacturer and point of extraction, harvest or recovery for each raw material.
 - 3. Product Data for Credit IEQ 4.2 for primers, paints and coatings used inside the building's weatherproofing system, printed documentation of the products VOC content.
- C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Evaluation Reports: For steel deck.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the authorities having jurisdiction.

2.2 ROOF DECK

- 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. Verco Manufacturing Co.
 2. ASC Profiles, Inc.; a Blue Scope Steel company.
 3. Approved Equal.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard
 2. Deck Profile: As indicated on Contract Drawings.
 3. Profile Depth: As indicated on Contract Drawings.
 4. Design Uncoated-Steel Thickness: As indicated on Contract Drawings.
 5. Span Condition: As indicated on Contract Drawings.
 6. Side Laps: As indicated on Contract Drawings.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Side-Lap Fasteners: As indicated on Contract Drawings.
- C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- E. Pour Stops and Girder Fillers: As indicated on Contract Drawings.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Galvanizing Repair Paint: ASTM A 780
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Locate deck bundles to prevent overloading of supporting members.
- C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members as indicated on the Contract Drawings.
- B. Side-Lap and Perimeter Edge Fastening: As indicated on Contract Drawings.
- C. End Bearing: Install deck ends over supporting frame as indicated on Contract Drawings:
 - 1. End Joints: As indicated on Contract Drawings.

- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

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. Interior and exterior non-load-bearing wall framing.
 - 2. Ceiling joist framing.
 - 3. Soffit framing.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications".
 - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
 - 3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MR 5: For products and materials with requirements for regional materials indicating location and distance from Project to material manufacturer and point of extraction, harvest or recovery for each raw material.
 - 3. Product Data for Credit IEQ 4.2 for primers, paints and coatings used inside the building's weatherproofing system, printed documentation of the products VOC content.

1.4 INFORMATIONAL SUBMITTALS

- A. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dietrich Metal Framing; a Worthington Industries Company.
 - 2. Nuconsteel; a Nucor Company.
 - 3. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Cold-Formed Steel Framing Design Standards:
 - 1. Wall Studs: AISI S211.
 - 2. Headers: AISI S212.

- B. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As Indicated on Contract Drawings.
 - 2. Coating: As Indicated on Contract Drawings.

2.4 INTERIOR and EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 - 2. Flange Width: As indicated on Contract Drawings.
 - 3. Section Properties: As indicated on Contract Drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 - 2. Flange Width: As indicated on Contract Drawings.
- C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 - 2. Flange Width: As indicated on Contract Drawings.
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 - b. Flange Width: As indicated on Contract Drawings.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 - b. Flange Width: As indicated on Contract Drawings.
- E. Vertical Deflection Clips: As indicated on Contract Drawings.

2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 2. Flange Width: As indicated on Contract Drawings.
 3. Section Properties: As indicated on Contract Drawings.

2.6 EXTERIOR CANOPY FRAMING

- A. Exterior Canopy Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As indicated on Contract Drawings.
 2. Flange Width: As indicated on Contract Drawings.
 3. Section Properties: As indicated on Contract Drawings.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.

5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Anchor Bolts: ASTM F 1554, Grade 36 , threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- C. Power-Actuated Anchors: Fastener 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.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 1. Fabricate framing assemblies using jigs or templates.
 2. Cut framing members by sawing or shearing; do not torch cut.
 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to the Contract Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed steel framing members by welding, or screw fastening. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Contract Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 INTERIOR and EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Contract Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to as indicated on Contract Drawings.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Contract Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at centers indicated on Contract Drawings.
 - 2. Bridging: As indicated on Contract Drawings.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 JOIST INSTALLATION

- 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 on Contract Drawings.
- 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 on Contract Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: As indicated on Contract Drawings.
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports as indicated on Contract Drawings.
 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Contract Drawings.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. 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.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. .
3. Metal ladders.
4. Ladder safety cages.
5. Metal floor plate and supports.
6. Structural-steel door frames.
7. Miscellaneous steel trim.
8. Metal bollards.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Prefabricated building columns.
2. Metal nosings and treads.
3. Paint products.
4. Grout.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.2: For paints and coatings, include printed statement of VOC content. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; .

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. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Zinc-Coated Steel Wire Rope: ASTM A 741.
 - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- I. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- J. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- K. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

- L. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- M. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- N. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

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 B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors and chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting," and Section 099600 "High-Performance Coatings."

- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 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.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
- E. General: Provide prefabricated building columns consisting of load-bearing structural-steel members. Fabricate connections to comply with details shown or as needed to suit type of structure indicated.

2.7 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3
 - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch- diameter steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung.
 - 6. Galvanize ladders, including brackets.
 - 7. Prime ladders, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.8 LADDER SAFETY CAGES

- A. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
- B. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
- C. Galvanize steel ladder safety cages, including brackets and fasteners.
- D. Prime steel ladder safety cages, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.9 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops. Plug-weld built-up members and continuously weld exposed joints. Reinforce frames and drill and tap as necessary to accept finish hardware.
 - 1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Galvanize exterior steel frames.
- C. Prime exterior steel frames with primer specified in Section 099600 "High-Performance Coatings."

2.10 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.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with primer specified in Section 099123 "Exterior Painting".

2.11 METAL BOLLARDS

- A. Fabricate metal bollards from 1/4-inch Retain subparagraph below if required; delete if bollards are concrete filled.
 - 1. Cap bollards with 1/4-inch- thick steel plate.
- B. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve.
- D. Prime bollards with primer specified in Section 099099123 "Exterior Painting".

2.12 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 and for grouting.

2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Galvanize loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with primer specified in Section 099099123 "Exterior Painting".."

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099113 "Exterior Painting" unless primers specified in Section 099600 "High-Performance Coatings" are indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

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.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
- C. Anchor bollards in concrete in formed or core-drilled holes. Fill annular space around bollard solidly with nonshrink grout.
- D. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Fill bollards solidly with concrete, mounding top surface to shed water.

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 nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: 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.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055313 - BAR GRATINGS

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 metal bar gratings.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
 - 2. Section 055100 "Metal Stairs" for grating treads and landings of steel-framed stairs.
 - 3. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, and supports. 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.

1.4 ACTION SUBMITTALS

- A. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 1. Product Data for Credit MR 5: For products and materials with requirements for regional materials indicating location and distance from Project to material manufacturer and point of extraction, harvest or recovery for each raw material.

2. Product Data for Credit IEQ 4.2 for primers, paints and coatings used inside the building's weatherproofing system, printed documentation of the products VOC content.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. **Alabama Metal Industries Corporation, a Gibraltar Industries company.**
 2. **All American Grating.**
 3. **BarnettBates Corporation.**
 4. **Borden Metal Products (Canada) Limited.**
 5. **Fisher & Ludlow.**
 6. **Grating Pacific, Inc.**
 7. **Grupo Metelmex, S.A. de C.V.**
 8. **Harsco Industrial IKG, a division of Harsco Corporation.**

9. MLP Steel Company; Laurel Steel Products Division.
10. Ohio Gratings, Inc.
11. Seidelhuber Metal Products; Division of Brodhead Steel Products.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Trench Drains: Concentrated load for H-20 truck loading.
 2. Limit deflection to L/400 or 1/8 inch, whichever is less.

2.3 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Welded Steel Grating @ Trench Drains:
 1. Grating Mark W 19 2 (1 1/4x 5/16) STEEL: 1 1/4-by-5/16-inch bearing bars at 1 3/16 inch o.c., and crossbars at 2 inches o.c.
 2. Traffic Surface: Plain.

2.4 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- D. Wire Rod for Bar Grating Crossbars: ASTM A 510.

2.5 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the authorities having jurisdiction.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.6 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- G. Do not notch bearing bars at supports to maintain elevation.

2.7 STEEL FINISHES

- A. Finish gratings, frames, and supports after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
 - 1. 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055313

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- 1.
 2. Rooftop equipment bases and support curbs.
 3. Plywood backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. LEED Submittals:
1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Power-driven fasteners.
 2. Powder-actuated fasteners.
 3. Expansion anchors.
 4. Metal framing anchors.

PART 2 - PRODUCTS

2.1 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, [fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
 - 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.

- F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2 PROTECTION

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

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Wall sheathing.
 2. Roof sheathing.
 3. Composite nail base insulated roof sheathing.
 4. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
- B. LEED Submittals:
1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For following products, from ICC-ES:
1. Preservative-treated plywood.
 2. Fire-retardant-treated plywood.
 3. Foam-plastic sheathing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
 - 1. Plywood.
 - 2. Oriented strand board.
 - 3. Particleboard underlayment.
 - 4. Hardboard underlayment.
- C. Plywood: DOC PS 1.
- D. Oriented Strand Board: DOC PS 2.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood unless otherwise indicated and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.5 WALL SHEATHING

- A. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
 - 1. Type and Thickness: Type X, 5/8 inch thick.
- B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. Type and Thickness: Type X, 5/8 inch thick.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153.

2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with [ASTM D 3498] that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 1. Adhesives shall have a VOC content of **50 g/L** or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives 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."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate wallandroof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products adhesive for bonding plastic laminate and cabinet hardware and accessories.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
1. Product Data Credit IEQ 4.1: For adhesives and sealants, documentation indicating VOC content of adhesives and sealants used inside the building's weatherproofing system .
2. Product Data for Credit IEQ 4.2: For paints and coatings, printed documentation indicating the VOC content of paints and coatings used inside the building's weatherproofing system.
3. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- D. Samples:
 - 1. Plastic laminates, for each color, pattern, and surface finish.
 - 2. Thermoset decorative panels, for each color, pattern, and surface finish.

1.3 INFORMATIONAL SUBMITTALS

- A. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Licensee of WI's Certified Compliance Program.
- B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
- B. Grade: Custom.
- C. Regional Materials: Plastic-laminate cabinets shall be manufactured within 500 miles of Project site.
- D. Certified Wood: Plastic-laminate cabinets shall be made from wood products certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Type of Construction: Face frame.

- F. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- G. Reveal Dimension: 1/2 inch (13 mm).
- H. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Pattern Direction: [Vertically for drawer fronts, doors, and fixed panels.
- I. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS].
 - 2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
 - 3. Drawer Bottoms: Thermoset decorative panels.
- J. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample.
 - 3. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish.
 - d. Patterns, matte finish.

2.2 WOOD MATERIALS

- A. 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. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2. Medium-Density Fiberboard: ANSI A208.2 made with binder containing no urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
4. Softwood Plywood: DOC PS 1.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
6. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
 1. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening[, self-closing.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid metal 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.

- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
- G. Shelf Rests: BHMA A156.9, B04013; metal.
- H. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; [full-extension] [full-overtravel-extension] type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
 - 4. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-100.
 - 5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
 - 6. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-200.
- I. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- J. Door Locks: BHMA A156.11, E07121.
- K. Drawer Locks: BHMA A156.11, E07041.
- L. Door and Drawer Silencers: BHMA A156.16, L03011.
- M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
 - 2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
 - 3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
 - 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
 - 5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 - 7. Satin Stainless Steel: BHMA 630.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.6 FABRICATION

- A. Complete fabrication, including assembly 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.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, 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.
- C. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

- D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
- E. Cabinets: Install 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.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

END OF SECTION 064116

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Polyurethane waterproofing.
 - 2. Polyester waterproofing.
 - 3. Latex-rubber waterproofing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show locations and extent of waterproofing.
 - 2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

- A. Single-Component, Modified Polyurethane Waterproofing:
ASTM C 836/C 836M and coal-tar free.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Anti-Hydro International, Inc;** A-H Seamless Membrane.
 - b. **BASF Construction Chemicals, LLC, Building Systems;** Sonoshield HLM 5000.
 - c. **Carlisle Coatings & Waterproofing Inc;** MiraSEAL.
 - d. **CETCO;** LDC 60.
 - e. **Neogard;** Neogard 7401.
 - f. **Polyguard Products, Inc;** Polyguard PG-250.
 - g. **United Coatings;** Elastall 1000.

2.2 TWO-COMPONENT POLYURETHANE WATERPROOFING

- A. Two-Component, Unmodified Polyurethane
Waterproofing: ASTM C 836/C 836M.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Carlisle Coatings & Waterproofing Inc;** CCW 703 Liqueiseal.
 - b. **Gaco Western LLC;** GacoFlex LM-60.
 - c. **Pacific Polymers International, Inc;** Elasto-Deck B.T. Two-Component.
 - d. **Urethane Polymers International, Inc;** UIM-6430.

2.3 POLYESTER WATERPROOFING

- A. Multicomponent, Reinforced, Unsaturated Polyester
Waterproofing: ASTM C 836/C 836M.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Kemper System, Inc;** Kemperol BR.

2.4 AUXILIARY MATERIALS

- A. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.
- B. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
 - 1. Adhesive: Manufacturer's recommended contact adhesive.
- C. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric.
- D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; and as recommended by manufacturer for substrate and joint conditions.
 - 1. Backer Rod: Closed-cell polyethylene foam.

2.5 PROTECTION COURSE

- A. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Henry Company;** Asphalt Protection Board.
 - b. **Soprema, Inc;** Sopraboard.
 - c. **W. R. Meadows, Inc;** Protection Course.
 - 2. Thickness: 1/4 inch (6 mm), nominal.
 - 3. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
 - 4. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer.

2.6 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated

to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m).

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Carlisle Coatings & Waterproofing;** CCW MiraDRAIN 6200.
 - b. **Grace Construction Products; W.R. Grace & Co. -- Conn;** Hydroduct 220.
 - c. **Urethane Polymers International, Inc;** EZE-DRAIN V-2.

2.7 INSULATION DRAINAGE PANELS

A. Geotextile-Faced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Owens Corning Insulating Systems LLC;** Insul-Drain.
 - b. **T. Clear Corporation, a subsidiary of Fin Pan Inc;** Thermadry 750.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

- F. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.
- G. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
- H. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
- I. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

3.2 WATERPROOFING APPLICATION

- A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.
- B. Unreinforced Waterproofing Applications:
 - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils .
- C. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
 - 1. For horizontal applications, install protection course loose laid over fully cured membrane.
 - 2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
 - 3. Insulation drainage panels may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

3.3 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install protection course before installing drainage panels.

3.4 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 INSULATION DRAINAGE PANEL INSTALLATION

- A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. Ensure that drainage channels are aligned and free of obstructions.
- C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
- D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.6 PROTECTION

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071416

SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes traffic coatings and pavement markings for the following applications:
 - 1. Pedestrian traffic.
 - 2. Vehicular traffic.
 - 3. Equipment-room floor.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including installation instructions.
- B. LEED Submittals:
 - 1. Product Test Reports for Credit SS 7.2: For traffic coatings that are roof coverings, documentation indicating compliance with Solar Reflectance Index requirement.
 - 2. Product Data for Credit IEQ 4.2: For field-applied traffic coatings and pavement-marking paint located inside the building's weatherproofing membrane, documentation including printed statement of VOC content.
- C. Shop Drawings: For traffic coatings.
 - 1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.
- D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.2 TRAFFIC COATING

- A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for pedestrian traffic vehicular traffic and equipment-room floor; according to ASTM C 957.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide or comparable product by one of the following:

- a. **Advanced Polymer Technology Corporation.**
- b. **BASF Construction Chemicals, LLC - Building Systems.**
- c. **Carlisle Coatings & Waterproofing Inc.**
- d. **Crossfield Products Corp.**
- e. **Euclid Chemical Company (The);** an RPM company.
- f. **Neogard;** Division of Jones-Blair.
- g. **POLY-CARB, Inc.**
- h. **Sherwin-Williams Company (The).**
- i. **Tremco Incorporated;** an RPM company.
- j. **Urethane Polymers International, Inc.**

- B. Primer: Liquid primer recommended for substrate and conditions by traffic-coating manufacturer.

- C. Preparatory and Base Coats: Polyurethaneepoxy.
- D. Intermediate Coat: Polyurethaneorepoxy.
 - 1. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.
- E. Topcoat: Polyurethaneorepoxy.
 - 1. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.
 - 2. Color: As selected by Architect from manufacturer's full range.
- F. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.
- G. Energy Performance: Provide traffic coating with an initial Solar Reflectance Index of not less than 78 when calculated according to ASTM E 1980 based on the testing of identical products by a qualified testing agency.
- H. VOC Content: Traffic coating shall have a VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Low-Emitting Materials: Traffic coating shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 ACCESSORY MATERIALS

- A. Joint Sealants: As specified in Section 079200 "Joint Sealants."
- B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.
- C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.
- D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

2.4 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.
 - 1. Color: Blue.

- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
 - 1. Color: White.
- C. VOC Content: Pavement-marking paints shall have a VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Low-Emitting Materials: Pavement-marking paints 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."

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application.
 - 1. Application of coating indicates acceptance of surfaces and conditions.
- B. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- C. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259. Do not acid etch.
 - 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
 - 2. Remove concrete fins, ridges, and other projections.
 - 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
 - 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.2 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.3 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.
- B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.4 TRAFFIC-COATING APPLICATION

- A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.
- B. Apply number of coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.
- D. Cure traffic coatings.

3.5 PAVEMENT MARKINGS

- A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with Architect and traffic coating has cured.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil- (0.4-mm-) minimum, wet film thickness.

3.6 PROTECTING AND CLEANING

- A. Protect traffic coatings from damage and wear during remainder of construction period.

- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071800

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Cast-in-place concrete.
 - 2. Concrete unit masonry.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of water repellent and substrate indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Chemical Products Industries, Inc.**; CP-2000E, CP-1000.
 - b. **Dayton Superior Corporation**; Weather Worker J-29-WB.
 - c. **Kelly-Moore Paint Company Inc.**; Kel-Seal 77.
 - d. Pecora Corporation; KlereSeal 910-W 920-W
 - e. **Specco Industries, Inc.**; Waterstopper S-40 Silane.
 - f. **Tamms Industries, Inc., Euclid Chemical Company (The)**; Barcade Silane 100.

- g. < Description in first paragraph below allows products to have up to 600 g/L of VOCs, which may exceed some state limitations on VOCs.

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 water-repellent manufacturer's requirements. Check moisture content in representative locations by method recommended by manufacturer.
 - 2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
 - 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

3.2 PREPARATION

- A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- B. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- C. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using low-pressure spray to the point of saturation. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
 - 1. Precast Concrete and Cast Stone: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Foam-plastic board insulation.
 - 2. Glass-fiber blanket insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research/evaluation reports.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 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. **DiversiFoam Products.**
 - b. **Dow Chemical Company (The).**
 - c. **Owens Corning.**
 - d. **Pactiv Building Products.**
 - 2. Type VI, 40 psi (276 kPa).

2.2 GLASS-FIBER BLANKET INSULATION

- 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. **CertainTeed Corporation.**
 2. **Guardian Building Products, Inc.**
 3. **Johns Manville.**
 4. **Knauf Insulation.**
 5. **Owens Corning.**
- B. **Recycled Content:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 35 percent.
- C. **Unfaced, Glass-Fiber Blanket Insulation:** ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. **Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation:** ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
- E. **Kraft-Faced, Glass-Fiber Blanket Insulation:** ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
- F. **Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation:** ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- G. **Foil-Faced, Glass-Fiber Blanket Insulation:** ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- H. **Eave Ventilation Troughs:** Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

2.3 VAPOR RETARDERS

- A. **Polyethylene Vapor Retarders:** ASTM D 4397, 10 mils (0.25 mm)thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
- B. **Vapor-Retarder Tape:** Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation 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. 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.

3.2 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install 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. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
 - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward interior of construction.
 - b. Interior Walls: Set units with facing placed toward areas of high humidity.

3.4 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.5 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
 - 1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
 - 2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
 - 3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building paper.
 - 2. Building wrap.
 - 3. Flexible flashing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), un-perforated.
- B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D; except with water-resistance rating not less than 1 hour.
- C. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **DuPont (E. I. du Pont de Nemours and Company); Tyvek Commercial Wrap.**
 - b. **Raven Industries Inc.; Fortress Pro Weather Protective Barrier.**
 - c. **Reemay, Inc.; Typar HouseWrap.**
 - 2. Water-Vapor Permeance: Not less than 50 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).

- D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Self-adhesive butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
 - c. Protecto Wrap Company; BT-25 XL.
 - d. Raven Industries Inc.; Fortress Flashshield.
 - e. Advanced Building Products Inc.; Wind-o-wrap.
 - f. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - g. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.
- B. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.
- C. Building Wrap: Comply with manufacturer's written instructions.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
 - 2. Lap flashing over water-resistive barrier at bottom and sides of openings.

3. Lap water-resistive barrier over flashing at heads of openings.

END OF SECTION 072500

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

1.1 SUMMARY

- A. Section includes fluid-applied, vapor-retarding and vapor-permeable membrane air barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For air-barrier products, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For air barriers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For air-barrier assemblies.
 - 1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly , 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront,

door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

- a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
- b. Include junction with roofing membrane, building corner condition,.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.
- B. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous orsynthetic polymer membrane.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Elastomeric, Modified Bituminous Membrane:**
 - 1) **Carlisle Coatings & Waterproofing Inc.;** Barriseal R.
 - 2) **Hohmann & Barnard, Inc.;** Textroflash Liquid.
 - 3) **Meadows, W. R., Inc.;** Air-Shield LM.
 - 4) **Tremco Incorporated, an RPM company;** ExoAir 120SP/R.
 - b. **Synthetic Polymer Membrane:**

- 1) Grace, W. R., & Co. - Conn.; Perm-A-Barrier Liquid.
- 2) Henry Company; Air-Bloc 32.
- 3) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight.

2. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
- b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E 96/E 96M.
- c. Ultimate Elongation: Minimum [500] percent; ASTM D 412, Die C.

2.4 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous membrane.

1. Products: Subject to compliance with requirements, provide the following] [provide one of the following:

a. Elastomeric, Modified Bituminous Membrane:

- 1) Henry Company; Air-Bloc 07.
- 2) Hohmann & Barnard, Inc.; Textroflash Liquid VP.
- 3) Meadows, W. R., Inc.; Air-Shield LMP.
- 4) Tremco Incorporated, an RPM company; ExoAir 220R.

b. Synthetic Polymer Membrane:

- 1) Carlisle Coatings & Waterproofing Inc.; Barritech VP.
- 2) Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.
- 3) Henry Company; Air-Bloc 31 or Air-Bloc 33.
- 4) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight VP.
- 5) Tremco Incorporated, an RPM company; ExoAir 230.

2. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
- b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M.
- c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.

2.5 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

- B. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- C. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- C. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.2 INSTALLATION

- A. General: Install fluid-applied membrane air-barrier and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install air-barrier assembly on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of air barrier to substrate with termination mastic.

- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transitions and flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal air-barrier assembly around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams. Slit and flatten fishmouths and blisters. Extend patches 6 inches (150 mm) beyond repaired areas.
- K. Fluid-Applied Membrane Material: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness applied in two equal coats
 - 2. Vapor-Permeable Membrane Air Barrier: Total [dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness applied in two equal coats as been tested and inspected by Owner's testing agency.
- L. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.
- C. Tests: As determined by Owner's testing agency from among the following tests:
 - 1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.
 - 2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.

3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. (207 kPa) according to ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
 - E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
 - F. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than **30** days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
 - G. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Test Reports for Credit SS 7.2: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.
- C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980.
- C. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low-slope roof products.
- D. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
 - 1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
 - 2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E 1980.

- E. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- F. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- H. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 30.
- J. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
 - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
 - 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. **Advanced Architectural Products.**

- b. AEP Span; a BlueScope Steel company.
 - c. Architectural Building Components.
 - d. Architectural Metal Systems; a Nucor company.
 - e. MBCI; a division of NCI Building Systems, L.P.
 - f. McElroy Metal, Inc.
 - g. Merchant & Evans.
 - h. Metal-Fab Manufacturing, LLC.
 - i. Metal Sales Manufacturing Corporation.
 - j. Morin; a Kingspan Group company.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.040 inch.
 - b. Exterior Finish: Three-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Clips: Two-piece floating to accommodate thermal movement.
 - a. Material: 0.064-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 4. Panel Coverage: 24 inches at Service Bay and Truck Wash Buildings; 18" at Administration Building Canopies.
 5. Panel Height: 3 inches at Service Bay and Truck Wash Buildings; 1-3/4" at Administration Building Canopies.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 3. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.

- B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-(25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish as indicated on drawings.
- E. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch-nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

- A. Panels and Accessories:
 1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
 2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
 3. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- B. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches.
 - 1. Apply over the entire roof surface.
 - 2. .
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 - 4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 5. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.

- b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.16

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exposed-fastener, lap-seam metal wall panels.
 - 2. Metal liner panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. .
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Box-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.
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. AEP Span; a BlueScope Steel company.
 - b. MBCI; a division of NCI Building Systems, L.P.
 - c. Metal Sales Manufacturing Corporation,
 - d. VICWEST.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.040 inch.
 - b. Exterior Finish: Three-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Rib Spacing: 8.0 inches o.c. at Administration Building; 7-3/16 inch at Service Bay and Truck Wash Buildings.
 4. Panel Coverage: 40 inches at Administration Building; 36 inches at Service Bay and Truck Wash Buildings.
 5. Panel Height: 1.0 inch at Administration Building; 1.5 inch at Service Bay and Truck Wash Buildings.

2.3 METAL LINER PANELS

- A. General: Provide factory-formed metal liner panels designed for interior side walls and field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for a complete installation.

- B. Metal Liner Panels Solid panels formed with intermediate stiffening ribs symmetrically spaced between panel edges; with a flush joint between panels.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Architectural Metal Systems; a Nucor company.
 - b. MBCI; a division of NCI Building Systems, L.P.
 - c. Metal Sales Manufacturing Corporation.
 - d. Morin; a Kingspan Group company.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.040 inch.
 - b. Exterior Finish: Three-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Panel Coverage: 24 inches.
 4. Seam Profile: Striated.
 5. Seam Height: 1 inch.
 6. Acoustical Performance: Where sound-absorption requirement is indicated, fabricate interior liner panels with 1/8-inch-diameter holes uniformly spaced approximately 1000 holes/sq. ft..
 - a. NRC of not less than 0.65 when tested according to ASTM C 423.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
3. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

- #### A. Miscellaneous Supports:
- Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.2 METAL PANEL INSTALLATION

- #### A. Lap-Seam Metal Panels:
- Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- #### B. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- #### C. Metal Liner Panels:
- Install panels on interior side of framing with flush appearance on the inside.

- D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.13

SECTION 074213.53 - METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal soffit panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces]

2.2 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
 - 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. AEP Span; a BlueScope Steel company.
 - b. Architectural Building Components.
 - c. ATAS International, Inc.
 - d. MBCI; a division of NCI Building Systems, L.P.
 - e. Metal-Fab Manufacturing, LLC.
 - f. Metal Sales Manufacturing Corporation.
 - 2. Material: Same material, finish, and color as metal wall panels.
 - 3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.040 inch.
 - b. Height: 1 inch
 - c. Coverage: 12 inches
 - d. Exterior Finish: Three-coat fluoropolymer.
 - e. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
3. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.2 METAL PANEL INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.

3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.53

SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mechanically fastened thermoplastic polyolefin (TPO) roofing system.
 - 2. Roof insulation.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit SS 7.2: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
 - 2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color required.
 - 2. Aggregate surfacing material in gradation and color required.
 - 3. Roof paver, full sized, in each color and texture required.
 - 4. Walkway pads or rolls, of color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Carlisle SynTec Incorporated.
 - 2. Flex Roofing Systems.
 - 3. GAF Materials Corporation.
 - 4. GenFlex Roofing Systems.
 - 5. Johns Manville.
- B. Source Limitations: Obtain components including roof insulation fasteners for roofing system from same manufacturer as membrane roofing.

2.2 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- C. Roofing System Design: Tested by a qualified testing agency to resist the wind loading criteria as indicated on Contract Drawings.

- D. Solar Reflectance Index: Not less than 78] when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- E. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- G. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING

- A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible fabric-backed TPO sheet.
 - 1. Thickness: 60 mils, nominal.
 - 2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Single-Ply Roof Membrane Sealants: 450 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
 - j. Other Adhesives and Sealants: 250 g/L.

3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
 - C. Bonding Adhesive: Manufacturer's standard, water based.
 - D. Slip Sheet: Manufacturer's standard, of thickness required for application.
 - E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
 - F. Miscellaneous Accessories: Provide metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate 1/2 inch thick.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. **CertainTeed Corporation;** GlasRoc Sheathing
 - b. **Georgia-Pacific Corporation;** Dens Deck
 - c. **National Gypsum Company;** Gold Bond eXP Extended Exposure Sheathing.
 - d. **Temple-Inland, Inc;** GreenGlass Exterior Sheathing.
 - e. **USG Corporation;** Securock Glass Mat Roof Board.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 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. **Atlas Roofing Corporation.**

- b. Carlisle SynTec Incorporated.
 - c. GAF Materials Corporation.
 - d. Hunter Panels.
 - e. Insulfoam LLC; a Carlisle company.
 - f. Johns Manville.
- B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
 - C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.7 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate 1/2 inch thick, factory primed.
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation; GlasRoc Sheathing.
 - b. Georgia-Pacific Corporation; Dens Deck.
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. Temple-Inland, Inc; GreenGlass Exterior Sheathing.
 - e. USG Corporation; Securock Glass Mat Roof Board.
- D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.8 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.2 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.3 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Install tapered insulation under area of roofing to conform to slopes indicated.
- C. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- D. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
 - 2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

3. Set each layer of insulation in insulation adhesive, firmly pressing and maintaining insulation in place.
- E. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - F. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
 3. Set each subsequent layer of insulation in insulation adhesive, firmly pressing and maintaining insulation in place.
 - G. Loosely Laid Insulation: Loosely lay insulation units over substrate.
 - H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
 1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
 - I. Install slip sheet over cover board and immediately beneath roofing.

3.4 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
- B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.
- D. Apply roofing with side laps shingled with slope of roof deck where possible.
- E. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.

- F. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- G. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit MR 5: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted

- ##### C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

- D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- 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 of typical roof edge eave, including built-in gutter, fascia, fascia trim and apron flashing, approximately 10 feet (3.0 m) long.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other

defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. SPRI Wind Design Standard: Manufacture and install copings, roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: [As indicated on Drawings] <Insert design pressure>.
- E. Recycled Content of Copper-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 40 percent.
- F. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- G. 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 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
 - 1. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: As selected by Architect from manufacturer's full range.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Surface: Mill phosphatized for field painting.
 - 2. Exposed Coil-Coated Finish:

- a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: As selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
 - g. Polyguard Products, Inc.; Deck Guard HT.
 - h. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
 - i. SDP Advanced Polymer Products Inc; Palisade SA-HT.
 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.
- B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand

design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.5 MANUFACTURED REGLETS

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions with interlocking counterflashing on exterior face, of same metal as reglet.
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. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products, Inc.
 - d. Hickman, W. P. Company.
 - e. Hohmann & Barnard, Inc.
 - f. Keystone Flashing Company, Inc.
 - g. National Sheet Metal Systems, Inc.

- h. Sandell Manufacturing.
- 2. Material: Galvanized steel, 0.022 inch (0.56 mm) thick.
- 3. Finish: With manufacturer's standard color coating.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-

(2400-mm-) long sections. Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

B. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.

1. Accessories: Wire-ball downspout strainer.
2. Fabricate from the Following Materials:
 - a. Stainless Steel: 0.016 inch (0.40 mm) thick.

C. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors Shop fabricate elbows.

1. Hanger Style:.
2. Fabricate from the following materials:
 - a. Galvanized Steel: 0.022 inch (0.56 mm)thick.

D. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Galvanized Steel: .028 inch (0.71 mm) thick.

E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.
- 2.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Fabricate from the Following Materials:
 - a. Galvanized Steel: 0.028 inch (0.71 mm) thick.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and

interior leg. Miter corners, fasten and seal, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Fabricate from the Following Materials:
 - a. Galvanized Steel: 0.040 inch (1.02 mm) thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.
- D. Counterflashing and Flashing Receivers: Fabricate from the following materials:
 1. Galvanized Steel: 0.022 inch (0.56 mm) thick.
- E. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.
 - 2.
- F. Roof-Drain Flashing: Fabricate from the following materials:
 1. Stainless Steel: 0.016 inch (0.40 mm)thick.

2.9 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 1. Stainless Steel: 0.016 inch (0.40 mm)thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 1. Galvanized Steel: 0.022 inch (0.56 mm)thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.

- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder metallic-coated steel sheet.
 - 2. Do not use torches for soldering.
 - 3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - 4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 - 5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
- C. Built-in Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.
 - 1. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing. Lap sides minimum of 2 inches (50 mm) over underlying course. Lap ends minimum of 4

inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with roofing nails. Install slip sheet over underlayment.

2. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
- D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
- E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch (25 mm) below scupper/gutter discharge.
- G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm).
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."
- C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."
- D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Roof hatches.
 - 4. Hatch-type heat and smoke vents.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 - 3. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For roof accessories.
- D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items.
- B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within **20** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Mill Finish: As manufactured.
 - 2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
 - 3. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.
 - 4. Color Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.
 - 5. Exposed Coil-Coated Finish: Two-coat fluoropolymer finish; AAMA 620; system consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - 6. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).
- B. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).

- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches (38 mm) thick.
- D. Security Grilles: 3/4-inch (19-mm) diameter, ASTM A 1011/A 1011M steel bars spaced 6 inches (150 mm) o.c. in one direction and 12 inches (300 mm) o.c. in the other; factory finished with manufacturer's or fabricator's standard, universal shop primer compatible with substrate and field-applied finish paint system indicated.
- E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- F. Sealants: As recommended by roof accessory manufacturer for installation indicated.

2.3 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units with integral spring-type vibration isolators and capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
 - 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. AES Industries, Inc.
 - b. Curbs Plus, Inc.
 - c. Custom Solution Roof and Metal Products.
 - d. Greenheck Fan Corporation.
 - e. LM Curbs.
 - f. Metallic Products Corp.
 - g. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - h. Pate Company (The).
 - i. Roof Products, Inc.
 - j. Safe Air of Illinois.
 - k. Thybar Corporation.
 - l. Vent Products Co., Inc.
- B. Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.
 - 1. Finish: Mill.
 - 2. Color: As selected by Architect from manufacturer's full range.
- C. Construction:

1. Insulation: Factory insulated with [1-1/2-inch- (38-mm-) thick -fiber board insulation.
2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
3. Factory-installed wood nailer at top of curb, continuous around curb perimeter.
4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
6. Top Surface: Level around perimeter with roof slope accommodated by sloping the deck-mounting flange.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
8. Security Grille: Provide where indicated.

2.4 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
 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. AES Industries, Inc.
 - b. Curbs Plus, Inc.
 - c. Custom Solution Roof and Metal Products.
 - d. Greenheck Fan Corporation.
 - e. LM Curbs.
 - f. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - g. Pate Company (The).
 - h. Roof Products, Inc.
 - i. Thybar Corporation.
 - j. Vent Products Co., Inc.
- B. Material: Zinc-coated (galvanized) steel sheet [0.079 inch (2.01 mm) thick.
 1. Finish: Two-coat fluoropolymer.
 2. Color: As selected by Architect from manufacturer's full range.
- C. Construction:

1. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick -fiber board insulation.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Factory-installed continuous wood nailers 5-1/2 inches (140 mm)wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
6. Fabricate equipment supports to minimum height of 12 inches (300 mm) unless otherwise indicated.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
8. Security Grille: Provide where indicated.

2.5 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant,stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
 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. AES Industries, Inc.
 - b. Babcock-Davis.
 - c. Bilco Company (The).
 - d. Bristolite Skylights.
 - e. Custom Solution Roof and Metal Products.
 - f. Dur-Red Products.
 - g. Hi Pro International, Inc.
 - h. J. L. Industries, Inc.
 - i. Metallic Products Corp.
 - j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - k. Naturalite Skylight Systems; Vistawall Group (The).
- B. Type and Size: Single-leaf lid, Size per plan.
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa)internal uplift load.
 1. Dome Glazing: Minimum 40-lbf/sq. ft. (1.9-kPa)external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

- D. Hatch Material: Aluminum-zinc alloy-coated steel sheet, 0.079 inch (2.01 mm) thick.
 - 1. Finish: Mill.
 - 2. Color: As selected by Architect from manufacturer's full range.

- E. Construction:
 - 1. Insulation: Polyisocyanurate board.
 - 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 3. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - 5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 6. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
 - 7. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

- F. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

- G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder. Post locks in place on full extension; release mechanism returns post to closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
 - C. Security Grilles: Weld bar intersections and, using tamper-resistant bolts, attach the ends of bars to structural frame or primary curb walls.
 - D. Seal joints with sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each joint-sealant product.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

- ##### C. Samples: For each kind and color of joint sealant required.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- ##### A. Product test reports.

- ##### B. Preconstruction laboratory test reports.

- ##### C. Preconstruction field-adhesion-test reports.

D. Field-adhesion-test reports.

E. Sample warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.

3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
1. Architectural sealants shall have a VOC content of 250 g/L or less.
 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
 3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **GE Construction Sealants;** SCS2700 SilPruf LM .
 - b. **Sika Corporation U.S.;** Sikasil WS-290.
- B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** 791.
 - b. **GE Construction Sealants;** SCS2000 SilPruf.
 - c. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 265 LTS.
 - d. **Pecora Corporation;** PCS.
 - e. **Sika Corporation U.S.;** Sikasil WS-295.
- C. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 35, Use NT.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **GE Construction Sealants;** SWS.
- D. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** 758.
 - b. **GE Construction Sealants;** SCS2350.
 - c. **Polymeric Systems, Inc.;** PSI-631.
 - d. **Schnee-Morehead, Inc., an ITW company;** SM5731 Poly-Glaze Plus.
- E. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** NS.
 - b. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 728 NS.
- F. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** 799.
 - b. **Soudal USA;** RTV 50.
- G. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 199 PG.
 - b. **Sika Corporation U.S.;** Sikasil-N Plus US.

- H. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 100/50, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 728 SG.

- I. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- J. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 200 SC Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type M, Grade P, Class 100/50, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 728 RCS.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability,

nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 290 FPS-NB
 - b. **Pecora Corporation;** 890FTS/TXTR.
 - c. **Tremco Incorporated;** Spectrem 1.
 - d. <
- C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** 756 SMS.
 - b. **GE Construction Sealants;** SilPruf NB.
 - c. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 295 FPS NB.
 - d. **Pecora Corporation;** 864NST.
 - e. **Tremco Incorporated;** Spectrem 2.
- D. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** 790.
- E. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Tremco Incorporated;** Spectrem 4-TS.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **BASF Construction Chemicals, LLC, Building Systems;** Sonalastic TX1.
 - b. **ER Systems, an ITW Company;** Pacific Polymers Elasto-Thane 230 MP.
 - c. **Pecora Corporation;** Dynatrol I-XL.
 - d. **Polymeric Systems, Inc.;** Flexiprene 1000.
 - e. **Schnee-Morehead, Inc., an ITW company;** Permthane SM7108.
 - f. **Sherwin-Williams Company (The);** Stampede-1.
 - g. **Sika Corporation U.S.;** Sikaflex Textured Sealant.
 - h. **Tremco Incorporated;** Dymonic.
- B. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Sika Corporation U.S.;** Sikaflex 15LM.
- C. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **LymTal International, Inc.;** Iso-Flex 330.
- D. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 35, Uses T and NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Bostik, Inc.;** Chem-Calk 955-SL.

- E. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **BASF Construction Chemicals, LLC, Building Systems;** Sonolastic SL 1.
 - b. **Pecora Corporation;** NR-201.
 - c. **Polymeric Systems, Inc.;** Flexiprene 952.
 - d. **Schnee-Morehead, Inc.; an ITW company;** Permthane SM7101.
 - e. **Sherwin-Williams Company (The);** Stampede 1SL.
- F. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Pecora Corporation;** Dynatrol II.
- G. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Sherwin-Williams Company (The);** Stampede-2NS.
- H. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Tremco Incorporated;** Dymeric 240.
- I. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T and NT.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Bostik, Inc.;** Chem-Calk 505.
 - b. **LymTal International, Inc.;** Iso-Flex 881.
 - c. **Sika Corporation U.S.;** Sikaflex - 2c NS EZ Mix.

- J. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **LymTal International, Inc.;** Iso-Flex 888QC.

- K. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Bostik, Inc.;** Chem-Calk 555-SL.
 - b. **LymTal International, Inc.;** Iso-Flex 880 GB.
 - c. **Pecora Corporation;** Dynatrol II SG
 - d. **Sherwin-Williams Company (The);** Stampede-2SL.
 - e. **Tremco Incorporated;** THC 900/901.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **Dow Corning Corporation;** 786-M White.
 - b. **GE Construction Sealants;** SCS1700 Sanitary.
 - c. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.;** Bondaflex Sil 100 WF.

- d. Soudal USA; RTV GP.
- e. Tremco Incorporated; Tremsil 200.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
- b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600.
- c. Pecora Corporation; AC-20.
- d. Sherwin-Williams Company (The); 850A.
- e. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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. BASF Construction Chemicals, LLC, Building Systems.
- b. Construction Foam Products, a division of Nomaco, Inc.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MR 5: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
- C. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required.
- F. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Amweld International, LLC.
 2. Apex Industries, Inc.
 3. Commercial Door & Hardware Inc.
 4. Concept Frames, Inc.
 5. Custom Metal Products.
 6. Daybar.
 7. Deansteel.
 8. Door Components, Inc.
 9. Fleming-Baron Door Products.
 10. Gensteel Doors Inc.
 11. Greensteel Industries, Ltd.
 12. Republic Doors and Frames.
 13. Rocky Mountain Metals, Inc.
 14. Security Metal Products Corp.
 15. Shanahans Manufacturing Ltd.
 16. Steelcraft; an Ingersoll-Rand company.

2.2 REGULATORY 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, based on testing at positive pressure according to NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Assemblies: Provide an 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 and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level C according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard.
3. Frames:
 - a. Materials: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - b. Construction: Full profile welded.
4. Exposed Finish: Factory.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard.
3. Frames:
 - a. Materials: Metallic-coated, steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.
4. Exposed Finish: Factory.

C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.

- b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - d. Edge Construction: Model 3, Stile and Rail.
 - e. Core: Manufacturer's standard.
3. Frames:
- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.
4. Exposed Finish: Factory.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

- 1. Physical Performance: Level B according to SDI A250.4.
- 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard insulation material.
- 3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
- 4. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
- 5. Exposed Finish: Factory.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.

- 1. Physical Performance: Level A according to SDI A250.4.
- 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.

- d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard insulation material.
3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
 4. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
 5. Exposed Finish: Factory.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) 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 frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- J. Glazing: Section 088000 "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.7 FABRICATION

- A. Fabricate hollow-metal work 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. 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.
 - 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight 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 butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
 - 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.

- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 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 work for hardware.

- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: SDI A250.10.

- B. Factory Finish: SDI A250.3.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 ACCESSORIES

- A. Louvers: Provide sightproof louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
 - 1. Fire-Rated Automatic Louvers: Movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated.

- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of 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.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and 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. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
- 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
- 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.2 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 work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- 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.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Hollow-core doors with wood-veneer faces.
3. Factory finishing flush wood doors.
4. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
2. Certificates for Credit MR 7: Chain-of-custody certificates indicating that flush wood doors comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services'

- "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 6. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
1. Dimensions and locations of blocking.
 2. Dimensions and locations of mortises and holes for hardware.
 3. Dimensions and locations of cutouts.
 4. Undercuts.
 5. Requirements for veneer matching.
 6. Doors to be factory finished and finish requirements.
 7. Fire-protection ratings for fire-rated doors.
- D. Samples: For factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body and is a certified participant in AWI's Quality Certification Program.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Algoma Hardwoods, Inc.
 2. Ampco.
 3. Chappell Door Co.
 4. Eggers Industries.
 5. General Veneer Manufacturing Co.
 6. Graham Wood Doors; an Assa Abloy Group company.
 7. Haley Brothers, Inc.
 8. Marshfield Door Systems, Inc.
 9. Oshkosh Door Company.
 10. Poncraft Door Company.
 11. Vancouver Door Company.
 12. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

- A. **Quality Standard:** In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards".
1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
- B. **Regional Materials:** Flush wood doors shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- C. **Certified Wood:** Flush wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. **Low-Emitting Materials:** Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- E. **Low-Emitting Materials:** Fabricate doors with adhesives and composite wood products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. **WDMA I.S.1-A Performance Grade:**

1. Heavy Duty unless otherwise indicated.
 2. Extra Heavy Duty: where indicated.
 3. Standard Duty: where indicated.
- G. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- H. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-1or, made with binder containing no urea-formaldehyde.
 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- I. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
- J. Mineral-Core Doors:
1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
- K. Hollow-Core Doors:
1. Construction: Standard hollow core.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Hollow-Core Doors :
1. Grade: Custom (Grade A faces).
 2. Species: White oak.
 3. Cut: Rotary cut.
 4. Match between Veneer Leaves: Book match.
 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.

6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Construction: Seven plies.

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.
- C. Metal Louvers:
 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. **Air Louvers, Inc.**
 - b. **Anemostat; a Mestek company.**
 - c. **L & L Louvers, Inc.**
 - d. **Louvers & Dampers, Inc.; a division of Mestek, Inc.**
 - e. **McGill Architectural Products.**
 2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.
 3. Metal and Finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

3. Louvers: Factory install louvers in prepared openings.

2.6 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.7 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 1. Install fire-rated doors according to NFPA 80.
 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

- a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.
 - 2. Floor access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples: For each door face material.
- E. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

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. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
6. Elmdor/Stoneman Manufacturing Co.; Div. of Acom Engineering Co.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges :

1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Wall and ceiling.
3. Door Size: 30" X 30".
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory prime. Factory finish.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory prime.
6. Frame Material: Same material, thickness, and finish as door.
7. Hinges: Manufacturer's standard.
8. Hardware: Latch.

D. Hardware:

1. Latch: Cam latch operated by hex-head wrench with interior release.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- E. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- F. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- G. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2 (ANSI H35.2M).
- H. Frame Anchors: Same type as door face.
- I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 - 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.

2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
- F. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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.
- D. Steel and Metallic-Coated-Steel Finishes:
1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices, and other accessories.
3. Include diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
 - 2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and meeting the acceptance criteria of DASMA 108.
- B. Windborne-Debris Impact Resistance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 3.
 - 1. Large-Missile Test: For overhead coiling doors located within 30 feet (9.144 m) of grade.
- C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 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. City-Gates.
 - b. Clopay Building Products.
 - c. Cookson Company.
 - d. Cornell Iron Works, Inc.
 - e. McKeon Rolling Steel Door Company, Inc.
 - f. Metro Door.
 - g. Overhead Door Corporation.
 - h. QMI Security Solutions.
 - i. Raynor.
- B. Operation Cycles: Door components and operators capable of operating for not less than 200,000.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 1-7/8-inch (48-mm) center-to-center height.

- E. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- G. Hood: .
 - 1. Mounting: Face of wall, As shown on Drawings.
- H. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.
- I. Manual Door Operator: Chain-hoist operator.
- J. Curtain Accessories: Equip door with weatherseals.
- K. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
 - 2. Interior Curtain-Slat Facing: Finish as selected by Architect from manufacturer's full range

2.3 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.

2.4 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. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- 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.

2.5 HOODS

- 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. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
 - 2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Chain Lock Keeper: Suitable for padlock.

2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
- B. 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.

2.8 COUNTERBALANCING 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. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.

- B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N)force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide tight fit around entire perimeter.

3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior storefront framing.
2. Storefront framing for window walls.
3. Storefront framing for punched openings.
4. Exterior manual-swing entrance doors and door-frame units.

1.2 PREINSTALLATION MEETINGS

- ##### **A. Preinstallation Conference: Conduct conference at Project site.**

1.3 ACTION SUBMITTALS

- ##### **A. Product Data: For each type of product.**

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

- ##### **C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.**

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- ##### **D. Samples: For each exposed finish required.**

- ##### **E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.**

- ##### **F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.**

1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Product test reports.
- C. Field quality-control reports.
- D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Manufacturer and/or Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

- E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 15 as determined according to NFRC 500.
- I. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 3.
1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

- J. Thermal Movements: Allow for thermal movements resulting 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Arcadia, Inc.
 2. Arch Aluminum & Glass Co., Inc.
 3. CMI Architectural.
 4. Kawneer North America.
 5. Pittco Architectural Metals, Inc.
 6. TRACO.
 7. United States Aluminum.
 8. YKK AP America Inc.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Centered.
 4. Finish: Color anodic finish.
 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.

- b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 - 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Pivot Hinges: BHMA A156.4, Grade 1.
 - 1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
 - 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 - 2. Exterior Hinges: Stainless steel, with stainless-steel pin
 - 3. Quantities:
 - a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
 - b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.
- F. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
- G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- H. Manual Flush Bolts: BHMA A156.16, Grade 1.
- I. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- K. Cylinders: As specified in Section 087100 "Door Hardware."
 - 1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".

- L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- M. Operating Trim: BHMA A156.6.
- N. Removable Mullions: BHMA A156.3, extruded aluminum.
 - 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- P. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- Q. Surface-Mounted Holders: BHMA A156.16, Grade 1.
- R. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- S. Weather Stripping: Manufacturer's standard replaceable components.
- T. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- U. Silencers: BHMA A156.16, Grade 1.
- V. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).
- W. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L.

- E. Sealants used inside the weatherproofing system 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 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the insulated sandwich panel system and accessories as shown and specified. Work includes providing and installing:

1. Wall assemblies

- B. Related Sections:

1. Sections 055000 Metal Fabrications for sub-framing around assemblies.

1.2 SUBMITTALS

- A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.

- B. LEED Submittals:

1. Product Data for Credit MR 4: Provide documentation demonstrating use of materials with a minimum 10% recycled content (post-consumer + ½ pre-consumer).

- C. Submit shop drawings. Include plans, elevations and details.

- D. Submit manufacturer's color charts showing the full range of colors available for factory finished aluminum.

1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.

a. Sandwich panels: 14" x 28" units

b. Factory finished aluminum: 5" long sections

- E. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

- F. Submit product reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Reports required (if applicable) are:

a. International Building Code Evaluation Report (AC 177)

- b. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
- c. Burn Extent (ASTM D 635)
- d. Color Difference (ASTM D 2244)
- e. Impact Strength (UL 972)
- f. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037)
- g. Bond Shear Strength (ASTM D 1002)
- h. Beam Bending Strength (ASTM E 72)
- i. Insulation U-Factor (NFRC 100)
- j. NFRC System U-Factor Certification (NFRC 700)
- k. Solar Heat Gain Coefficient (NFRC or Calculations)
- l. Condensation Resistance Factor (AAMA 1503) (Thermally Broken only)
- m. Air Leakage (ASTM E 283)
- n. Structural Performance (ASTM E 330)
- o. Water Penetration (ASTM E 331)
- p. 1200°F Fire Resistance (SWRI)
- q. LEED Credits

1.3 CLOSEOUT SUBMITTALS

- A. Provide field maintenance manual to include in project maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

- B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

1.5 PERFORMANCE REQUIREMENTS

- A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
2. Structural Loads (Wall Assemblies). Provide system capable of handling the following loads:
 - a. Positive Wind Load (PSF): 31 PSF

B. Deflection Limits:

1. Wall Panel Assemblies: Limited to L/60 of clear span for each assembly component.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver panel system, components and materials in manufacturer's standard protective packaging.
- B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.7 WARRANTY

- A. Provide manufacturer's and installer's written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within one year from the date of delivery. Failure of materials or workmanship shall include excessive deflection, deterioration of finish on metal in excess of normal weathering, defects in accessories, insulated translucent sandwich panels and other components of the work.
- B. Extended Panel Warranty: 10 year Limited Warranty covering separation of faces from grid core affecting structural strength, reinforcing fiberbloom and/or abnormal color change of the exterior face sheet from date of delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The basis for this specification is for products manufactured by Kalwall Corporation. Other fiberglass translucent panel manufacturers may bid this project subject to compliance with the performance requirements of this specification and submission of evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.
- B. Kalwall Corporation, locally represented by Collier Building Specialties, (415) 467-9235, or equal.

2.2 PANEL COMPONENTS

A. Face Sheets:

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
 - a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
 - b. Face sheets shall not deform, deflect, or drip when subjected to fire or flame.
2. Interior face sheets:
 - a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 50 and smoke developed no greater than 250 when tested in accordance with UL 723.
 - b. Burn extent by ASTM D 635 shall be no greater than 1”.
3. Exterior face sheets:
 - a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after [5] years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
 - b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4” diameter, 5 lb. free-falling ball per UL 972.
 - c. Erosion Protection: Integral, embedded-glass erosion barrier.
4. Appearance:
 - a. Exterior face sheet: Smooth, .070” thick and White in color.
 - b. Interior face sheet: Smooth, .045” thick and White in color.
 - c. Face sheets shall not vary more than ± 10% in thickness and be uniform in color.

B. Grid Core:

1. Aluminum I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16”.
2. I-beam Thermal break: Minimum 1”, thermoset fiberglass composite.

C. Laminate Adhesive:

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council “Acceptance Criteria for Sandwich Panel Adhesives”.
2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:

- a. 50% Relative Humidity at 68° F: 540 PSI
- b. 182° F: 100 PSI
- c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
- d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

2.3 PANEL CONSTRUCTION

- A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.
 - 1. Thickness: 2-3/4 inches
 - 2. Light transmission: 20%
 - 3. Solar heat gain coefficient 0.38
 - 4. Panel U-factor by NFRC certified laboratory:
 - a. 2-3/4" aluminum grid 0.53
 - 5. Complete insulated panel system shall have NFRC certified U-factor of 0.62.
 - 6. Grid pattern as viewed: Nominal size 20 x 12 ; pattern Shoji
- B. Standard panels shall deflect no more than 1.9" at 30 PSF in 10'-0" span without a supporting frame by ASTM E 72.
- C. Standard panels shall withstand 1200° F fire for minimum one hour without collapse or exterior flaming.
- D. Thermally broken panels: Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.

2.4 CLOSURE SYSTEM

- A. Closure system:
 - 1. Standard extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.
- B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.
- C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.
- D. Finish:
 - 1. Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to be custom color Kalwall corrosion resistant finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Installer shall examine substrates, supporting structure and installation conditions.
- B. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3.3 INSTALLATION

- A. Install the panel system in accordance with the manufacturer's suggested installation recommendations and approved shop drawings.
 - 1. Anchor component parts securely in place by permanent mechanical attachment system.
 - 2. Accommodate thermal and mechanical movements.
 - 3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.
- B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturers suggested installation instructions.

3.4 CLEANING

- A. Clean the panel system interior and exterior, immediately after installation.
- B. Refer to manufacturer's written recommendations.

END OF SECTION 084523

SECTION 085123 - STEEL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel windows from hot-rolled sections.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide steel windows capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing windows that are representative of those specified according to ASTM E 330 or structural calculations:

1. Design Wind Loads: Determine design wind loads under conditions indicated according to ASCE/SEI 7.
 - a. Basic Wind Speed: 90 mph (40 m/s).
 - b. Importance Factor: 1.15.
 - c. Exposure Category: C.
2. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressures.

B. Windborne-Debris Resistance: Provide glazed steel windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed steel windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

C. Condensation-Resistance: Provide steel windows with a CRF when tested according to AAMA 1503 of 36 minimum.

D. Thermal Transmittance: Provide steel windows with the maximum whole-fenestration product U-factor indicated, when tested according to AAMA 1503.

1. U-Factor: $[0.49 \text{ Btu/sq. ft.} \times h \times \text{deg F}] [2.8 \text{ W/sq. m} \times \text{K}] <\text{Insert value}>$.

E. Solar Heat-Gain Coefficient (SHGC): Provide steel windows with a maximum whole-fenestration product SHGC of 0.40, determined according to NFRC 200.

F. Air Infiltration for Weather-Stripped Ventilators: Not more than 0.37 cfm/ft. (0.18 L/s per m) of ventilator crack length at an inward test pressure of 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E 283.

- G. Air Infiltration for Non-Weather-Stripped Ventilators: Not more than 1.0 cfm/ft. (0.47 L/s per m) of ventilator crack length at an inward test pressure of 1.56 lbf/sq. ft. (75 Pa) when tested according to ASTM E 283.
- H. Water Penetration: No leakage for 15 minutes when window is subjected to a rate of flow of 5 gal./h per sq. ft. (0.05 L/s per sq. m) with a differential pressure across the window of 2.86 lbf/sq. ft. (137 Pa) when tested according to ASTM E 331.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Product Schedule: For steel windows. Use same designations indicated on Drawings.
- F. Delegated-Design Submittal: For steel windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Field quality-control reports.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. SWI Publication: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" except where more stringent requirements are indicated.
- B. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection.
 - c. Water leakage or air infiltration.
 - d. Faulty operation of operable sash and hardware.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Three years from date of Substantial Completion.
 - 3. Warranty Period for Metal Finishes: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. **Hot-Rolled Steel Windows:**
 - a. **A & S Window Associates, Inc.**
 - b. **Bliss Nor-Am Doors & Windows Ltd.**
 - c. **Clement Steel Windows Ltd.**
 - d. **Crittall Windows Ltd.**
 - e. **Hope's Windows, Inc.**
 - f. **Optimum Window Manufacturing Corp .**
 - g. **Torrance Steel Window Co., Inc.**

2.2 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Fasteners: Provide fasteners of bronze, brass, stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of steel windows.
- C. Anchors, Clips, and Window Accessories: Provide units of stainless steel, hot-dip zinc-coated steel, bronze, brass, or iron complying with ASTM A 123/A 123M. Provide units with sufficient strength to withstand design pressure indicated.
- D. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when steel window is closed.
- E. Sliding-Type Weather Stripping: Provide manufacturer's standard woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.
 - 1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.
- F. Trim Members, Screen Frames, Retainers for Weather Stripping, Flashing, and Similar Items: Manufacturer's standard.
- G. Glazing Stops: Manufacturer's standard.
- H. Sealant: For sealants required within fabricated windows, provide manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 WINDOW

- A. Window Type: As indicated in a schedule.
- B. Hot-Rolled Steel Window Members: Provide frame and ventilator members formed from hot-rolled, new billet steel sections. Provide SWI heavy intermediate windows.
 - 1. Window Finish: Baked enamel.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- C. Glass and Glazing System: See Section 088000 "Glazing" for glass units and glazing requirements for steel windows.

- D. Hardware: Provide manufacturer's standard malleable iron hardware, with operating components of stainless steel, carbon steel complying with AAMA 907, brass, bronze, or other corrosion-resistant material designed to operate smoothly, to close tightly, and to lock steel window ventilators securely. Provide hardware of sufficient strength to accommodate size and weight of ventilator for which it is intended.
- E. Insect Screens: Locate screens on outside of window and provide for each operable exterior sash or ventilator.
 - 1. Glass-Fiber Mesh Fabric: ASTM D 3656, 20-by-20 or 20-by-30 count per sq. in. (645 sq. mm) mesh of PVC-coated, glass-fiber threads.

2.4 FABRICATION

- A. General: Fabricate steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.
- B. Mullions: Formed of hot-rolled steel matching window units; with anchors for support to structure and for installation of window units and having sufficient strength to withstand design pressure indicated. Provide mullions of profile indicated and with cover plates. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections.
- C. Subframes and Operable Ventilators: Formed of cold-formed steel of profile indicated. Miter or cope corners, and weld and dress joints smooth.
- D. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.

2.5 METALLIC-COATED STEEL SHEET FINISHES

- A. 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 complying with SSPC-Paint 20 and ASTM A 780.
- B. Factory Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

2.6 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning"
- B. Galvanized Finish: Hot-dip galvanize per ASTM A 123.
- C. Steel and Galvanized-Steel Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
- D. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
- E. High-Performance Organic Finish: Two-coat fluoropolymer finish containing not less than **70** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Separate corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E 2112, Section 5.12 "Dissimilar Materials."
- C. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- D. Clean factory-finished steel surfaces immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes.
- E. Refinish or replace windows with damaged finish.

END OF SECTION 085123

SECTION 086200 - UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-flashing unit skylights with integral curbs.
2. Unit skylights mounted on prefabricated curbs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of unit skylight.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings: For unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

D. Samples: For each type of exposed finish required and each type of glazing.

E. Product Schedule: For unit skylights. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Bristolite Skylights.
 2. Fiore Skylights, Inc.; a division of Pepco Manufacturing Co.
 3. Fox Lite, Inc.; Skymaster Skylights.
 4. Glazed Structures Inc.
 5. Naturalite Skylight Systems; Oldcastle Glass Engineered Products.
 6. Plasteco, Inc.
 7. Skyline Sky-Lites, LLC.
 8. Solar Industries, Inc.
 9. Wasco Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Performance Class and Grade: Class R-PG 25.
 2. Performance Class and Grade: Class CW-PG 40.
 3. Certification: AAMA-, WDMA-, or CSA-certified unit skylights with label attached to each.
- B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.55 Btu/sq. ft. x h x deg F (3.12 W/sq. m x K).
- C. Windborne-Debris-Impact Resistance: Provide unit skylights that pass enhanced-protection testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than unit skylights indicated for use on Project and shall be installed in same manner as unit skylights indicated for use on Project.
1. Large-Missile Test: For unit skylights located within 30 feet (9.1 m) of grade.
 2. Small-Missile Test: For unit skylights located more than 30 feet (9.1 m) above grade.

3. Large-Missile Test: For all unit skylights regardless of height above grade.

2.3 UNIT SKYLIGHTS

- A. Unit Shape and Size: As indicated.
- B. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).
 1. Double-Glazing Profile: Dome, 25 percent rise.
 - a. Thicknesses: Not less than thicknesses required to exceed performance requirements.
 - b. Outer Glazing Color: White, translucent.
 - c. Inner Glazing Color: Colorless, transparent.
 2. Self-Ignition Temperature: 650 deg F (343 deg C) or more for plastic sheets in thickness indicated when tested according to ASTM D 1929.
 3. Smoke-Production Characteristics: Smoke-developed index of 450 or less when tested according to ASTM E 84, and smoke density of 75 or less when tested according to ASTM D 2843
 4. Burning Characteristics: Tested according to ASTM D 635. Class CC2, burning rate of 2-1/2 inches (64 mm) per minute or less for nominal thickness of 0.060 inch (1.5 mm) or thickness indicated for use.

2.4 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.
- B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.
- C. Perform test for total area of each unit skylight.
- D. Work will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.3 CLEANING

- A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

END OF SECTION 086200

**SECTION 086250
TUBULAR DAYLIGHT SYSTEM**

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Tubular Daylighting System, consisting of roof dome, reflective tube, and diffuser assembly; configuration as indicated on the Drawings.
- B. Accessories.
- C. Related Sections include but are not limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.
 - 3. Section 075423 - Fully Adhered TPO Roofing.

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
 - 2. ASTM A 463/A 463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process; 2001a.
 - 3. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process; 2001a.
 - 4. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 5. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.
 - 6. ASTM D-1929 - Test Method for Ignition Properties of Plastics.
 - 7. UL 181 - Factory Made Air Ducts and Air Connectors; 1998.
 - 8. UL 790 - Standard for Tests for Fire Resistance of Roof Covering Materials; 1997.
 - 9. ICBO/ICC AC-16 - Acceptance Criteria for Plastic Skylights; 2003.

1.03 PERFORMANCE REQUIREMENTS

- A. Completed tubular daylighting system assemblies shall be capable of meeting the following performance requirements:
 - 1. Air Infiltration Test:
 - a. Air infiltration will not exceed 0.30 CF/minute/SQ FT aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.

2. Water Resistance Test:
 - a. No uncontrolled water leakage at 16.5 psf pressure differential with water rate of 5 GAL/HRS/SQ FT when tested in accordance with ASTM E 331.
3. Uniform Load Test:
 - a. No breakage, permanent damage to fasteners, hardware parts, or damage to make system inoperable or cause permanent deflection of any section in excess of 1 percent of its span at a Positive Load of 110 psf or Negative Load of 60 psf.
 - b. All units shall be 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.
4. Fire Testing:
 - a. Class B Burning Brand:
 - 1) The burning brand shall self-extinguish without transferring the fire to the dome Per: U.B.C. Standard 15-2 Class B Burning Brand Test.
 - 2) See ASTM E 108 and UL 790.
 - b. Self-Ignition Temperature:
 - 1) Greater than 650 DegF Per: U.B.C. Standard 26-6.
 - 2) See ASTM D-1929-68 (1975).
 - c. Smoke Density:
 - 1) Rating no greater than 75 Per: U.B.C. Standard 26-5.
 - 2) (See ASTM D-2843-70) or no greater than 450 Per U.B.C. 8-1 (See ASTM Standard E 84-91A) in way intended for use.
 - d. Rate of Burn:
 - 1) Minimum Burning Rate: 2.5 IN/minute (64 mm/min) Classification CC-2: U.B.C. Standard 26-7.
 - a) See ASTM D 635.
5. Maximum assembly U-Value = 0.60 (BTU/HR-SF-F).

1.04 SUBMITTALS

- A. Submittal Procedures: See Section 013300 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.
- B. Leadership in Energy and Environmental Design (LEED[®]) Documentation: Submit the following in accordance with Section 01 81 30 – Sustainability Requirements.
 1. Product Data for MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content; include statement indicating costs for each product having recycled content.

2. Product Data for MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 3. Product Data for IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 4. LEED Materials Tracking Form: Form to be provided in an electronic format to the Contractor to record LEED materials used on the project.
- C. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- D. Quality Assurance Submittals:
1. Verification Samples: As requested by Project Representative.
 2. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.
- E. Closeout Submittals:
1. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section in accordance with the provisions of Section 017700 – Closeout Procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engaged in manufacture of tubular skylights for minimum 10 years.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local Authorities Having Jurisdiction.

1.07 PROJECT CONDITIONS

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

1.08 EXTENDED WARRANTY

- A. In accordance with the provisions of Section 017700 – Closeout Procedures, provide an Extended Warranty for the Work of this Section for ten (10) years commencing on the date of Substantial Completion.
 - 1. Tubular Daylighting System: Manufacturer's standard warranty for 10 years.
 - 2. Electrical Parts: Manufacturer's standard warranty for 5 years, unless otherwise indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Solatube International, Inc., (www.solatube.com).
 - 2. SolaDesign Systems LLC (www.sola-design.com).
 - 3. Daylighting Systems Inc. (www.daylighting.com).
 - 4. Or approved equal.
- B. Requests for substitutions will be considered in accordance with provisions of Section 016000 – Product Requirements.

2.02 MATERIALS

- A. Tubular Daylighting System General:
 - 1. Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICBO/ICC AC-16.
- B. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - 1. Outer Dome Glazing:
 - a. Type DA, 0.125 IN minimum thickness impact resistant injection molded acrylic classified as CC2 material and meeting characteristics of DR-101 blend.
 - b. Visible light transmission minimum 92 percent.
 - 2. Optional Shock Inner Dome Glazing:
 - a. Type DI, 0.115 IN minimum thickness high impact resistant injection molded acrylic required for high velocity wind zones.
 - 3. Prismatic pattern molded into dome to capture low angle sunlight.
 - 4. Light Tracker Reflector:
 - a. Aluminum sheet, thickness 0.015 IN with Spectralight Infinity.
 - b. Positioned in dome to capture low angle sunlight.

5. Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
 - a. Base Material: Sheet steel, corrosion resistant, meeting ASTM A 653/A 653M or ASTM A 463/A 463M, 0.028 IN thick.
 - b. Base Flat: Flat Type FF4, no pitch 4 IN high.
 - c. Base Flat: Flat Type FF6, no pitch 6 IN high.
 - d. Base Pitched: Pitched Type FPM, 22.5 degrees slope from horizontal, 4 IN high.
 - e. Flashing Insulator: Type F1. Thermal isolation material for use under flashing.
 - f. Dome Edge Protection Band: Type PB, for fire rated roofs.
 - 1) Aluminized steel. Nominal thickness of 0.028 IN.
6. Roof Flashing Turret Extensions: Provide manufacturer's standard extensions for applications requiring:
 - a. Additional lengths of 2 IN extension.
7. Dome Ring: Attached to top of base section; 0.090 IN nominal thickness injection molded high impact acrylic; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
8. Reflective Extension Tube: Aluminum sheet, thickness 0.015 IN.
 - a. Interior Finish:
 - 1) Spectralight Infinity high reflectance specular finish on exposed reflective surface.
 - 2) Visible spectrum (400 nm to 760 nm) greater than 99 percent.
 - 3) Total solar spectrum (400 nm to 2500 nm) less than 93 percent.
 - b. 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 E308.
 - c. Tube Diameter: Approximately 14 IN.
9. Reflective 30 degree Adjustable tube: Aluminum sheet, thickness 0.015 IN.
 - a. Interior Finish:
 - 1) Spectralight Infinity high reflectance specular finish on exposed reflective surface.
 - 2) Visible spectrum (400 nm to 760 nm) greater than 99 percent.
 - 3) Total solar spectrum (400 nm to 2500 nm) less than 93 percent.
10. Ceiling Ring: Injection molded impact resistant acrylic. Nominal thickness is 0.110 IN.

11. Dual Glazed Diffuser Assembly:

- a. Upper glazing:
 - 1) Acrylic plastic classified as CC2 material.
 - 2) The nominal thickness is 0.040 IN.
- b. Lower glazing (Optiview Fresnel Lens):
 - 1) Molded polycarbonate plastic classified as CC1 material.
 - 2) The nominal thickness is 0.022 IN.
- c. Lower glazing (Vusion):
 - 1) Acrylic plastic classified as CC2 material.
 - 2) The nominal thickness is 0.090 IN.
- d. Diffuser Trim Ring: Injection molded acrylic.
 - 1) White Trim (Optiview Fresnel Lens): Type L1.
- e. Effect Lens:
 - 1) Acrylic plastic classified as CC2 material.
 - 2) The nominal thickness is 0.090 IN.
 - a) Warm Effect Lens: Type WL.

2.03 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

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Project Representative of unsatisfactory preparation before proceeding.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. After installation of first unit, field test to determine adequacy of installation.
 - 1. Conduct water test in presence of Project Representative, or Contractor, or their designated representative.
 - 2. Correct if needed before proceeding with installation of subsequent units.

3.04 PROTECTION

- A. Protect installed products until completion of Project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 086250

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Folding doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

1. All hardware to be installed under other Sections.
2. Permanent lock cores to be installed by Owner.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings: Details of electrified door hardware.

D. Samples: For each exposed product and for each color and texture specified.

E. Other Action Submittals:

1. Door Hardware Schedule: 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

schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

- a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
- b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 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. Door Hardware: Locks, Hinges, Exit Devices, Door Closers
 2. Electrical Parts As specified in hardware schedule

1.4 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.
- B. Architectural Hardware Consultant Qualifications: A person 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 and who is currently certified by DHI as follows:
 1. For door hardware, an Architectural Hardware Consultant (AHC)] [Architectural Hardware Consultant (AHC) Retain first paragraph below if applicable.
- C. Source Limitations: 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. 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.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [ICC/ANSI A117.1] [HUD's "Fair Housing Accessibility Guidelines"] [and] <Insert regulation>.
 - 1. 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
 - 2. 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. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than [1/2 inch (13 mm) high] [and] [3/4 inch (19 mm) high for exterior sliding doors].
 - 4. 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.
- I. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- B. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 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. Warranty Period: Three (3) years from date of Substantial Completion, unless otherwise indicated.
 - a. Mechanical and Electromagnetic Locks: Five (5) years from date of Substantial Completion.
 - b. Exit Devices: Two (2) years from date of Substantial Completion.
 - c. Manual Closers: Ten (10) years from date of Substantial Completion.
 - d. Concealed Floor Closers: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article] to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.as referenced].
 - 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 Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1. [Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Bommer Industries, Inc.
- b. Hager Companies.
- c. IVES Hardware; an Ingersoll-Rand company.
- d. McKinney Products Company; an ASSA ABLOY Group company.
- e. PBB, Inc.
- f. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 CENTER-HUNG AND OFFSET PIVOTS

- A. Center-Hung and Offset Pivots: BHMA A156.4.

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. DORMA Architectural Hardware; Member of The DORMA Group North America.
- b. IVES Hardware; an Ingersoll-Rand company.
- c. Rixson Specialty Door Controls; an ASSA ABLOY Group company.

2.4 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

- B. Pin-and-Barrel-Type Hinges:

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

- a. Hager Companies.
- b. IVES Hardware; an Ingersoll-Rand company.

- c. Markar Architectural Products, Inc.; a subsidiary of Adams Rite Manufacturing Co.
 - d. McKinney Products Company; an ASSA ABLOY Group company.
 - e. Select Products Limited.
 - f. Zero International.
- C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
- 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. Bommer Industries, Inc.
 - b. Hager Companies.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. McKinney Products Company; an ASSA ABLOY Group company.
 - e. Select Products Limited.
 - f. Stanley Commercial Hardware; Div. of The Stanley Works.
 - g. Zero International.

2.5 MECHANICAL LOCKS AND LATCHES

- A. 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.
- 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- B. Bored Locks: BHMA A156.2; Grade [1] [2]; Series 4000.
- 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Dorma USA
 - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - c. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.

- f. Yale Security Inc.; an ASSA ABLOY Group company.
 - g. <Insert manufacturer's name>.
 - h. Yale Security Inc.; an ASSA ABLOY Group company
- C. Narrow Stile Auxiliary Locks: BHMA A156.5; Grade [1] [2]; with strike that suits frame.
- 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. Accurate Lock & Hardware Co.
 - b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.

2.6 ELECTROMECHANICAL LOCKS

- A. Electromechanical Locks: BHMA A156.25; Grade [1] [2]; motor or solenoid driven; **bore**]; with strike that suits frame.
- 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - b. Dorma.
 - c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - d. Schlage Commercial Lock Division; an Ingersoll-Rand company.
 - e. Security Door Controls.
 - f. Yale Security Inc.; an ASSA ABLOY Group company.

2.7 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
- 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. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. Burns Manufacturing Incorporated.
 - c. Don-Jo Mfg., Inc.
 - d. Door Controls International, Inc.
 - e. Hiawatha, Inc.
 - f. IVES Hardware; an Ingersoll-Rand company.
 - g. Trimco.

2.8 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Door Controls International, Inc.
- b. IVES Hardware; an Ingersoll-Rand company.
- c. Trimco.

2.9 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
- b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
- c. DORMA Architectural Hardware; Member of The DORMA Group North America.
- d. Monarch Exit Devices & Panic Hardware; an Ingersoll-Rand company.
- e. Precision Hardware, Inc.; Division of Stanley Security Solutions, Inc.
- f. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- g. Von Duprin; an Ingersoll-Rand company.
- h. Yale Security Inc.; an ASSA ABLOY Group company.

2.10 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: Same manufacturer as for locking devices.
2. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

- a. ASSA, Inc.; An ASSA ABLOY Group Company.

- b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - c. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.
 - f. Yale Security Inc.; an ASSA ABLOY Group company.
 - g. Dorma
- B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.11 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
- 1. No Master Key System: Only change keys operate cylinder.
 - 2. Master Key System: Change keys and a master key operate cylinders.
 - 3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
 - 4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
 - 5. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 - 6. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
- 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "**DO NOT DUPLICATE.**"
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Great-Grand Master Keys: Five.

2.12 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
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. American Key Boxes and Cabinets.
 - b. GE Security, Inc.
 - c. HPC, Inc.
 - d. Lund Equipment Co., Inc.
 - e. MMF Industries.
 - f. Tri Palm International.
 - g. <Insert manufacturer's name>.
 2. Multiple-Drawer Cabinet: Cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
 3. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
 4. Portable Cabinet: Tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.13 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel], unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Don-Jo Mfg., Inc.
 - b. Forms + Surfaces.
 - c. Hager Companies.
 - d. IVES Hardware; an Ingersoll-Rand company.
 - e. Rockwood Manufacturing Company.
 - f. Trimco.

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. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.15 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; 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. 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. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - b. DORMA Architectural Hardware; Member of The DORMA Group North America.
 - c. LCN Closers; an Ingersoll-Rand company.
 - d. Norton Door Controls; an ASSA ABLOY Group company.
 - e. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - f. Yale Security Inc.; an ASSA ABLOY Group company.

2.16 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass or, bronze
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Don-Jo Mfg., Inc.
 - b. Door Controls International, Inc .
 - c. Hager Companies.
 - d. Hiawatha, Inc.
 - e. IVES Hardware; an Ingersoll-Rand company.
 - f. Rockwood Manufacturing Company.
 - g. Stanley Commercial Hardware; Div. of The Stanley Works.
 - h. Trimco.

2.17 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) 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.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Hager Companies.
 - b. M-D Building Products, Inc.
 - c. National Guard Products.
 - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - e. Reese Enterprises, Inc.
 - f. Sealeze; a unit of Jason Incorporated.
 - g. Zero International.

2.18 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Hager Companies.
 - b. M-D Building Products, Inc.
 - c. National Guard Products.
 - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - e. Reese Enterprises, Inc.
 - f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - g. Sealeze; a unit of Jason Incorporated.
 - h. Zero International.
 - i. <Insert manufacturer's name>.

2.19 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
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. Don-Jo Mfg., Inc.

- b. Hiawatha, Inc.
- c. IVES Hardware; an Ingersoll-Rand company.
- d. Rockwood Manufacturing Company.
- e. Trimco.

2.20 FABRICATION

- A. 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. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames[;
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.21 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. Mounting Heights: Mount door hardware units at heights to comply with the following 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- D. 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. 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.
- E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- F. 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 (750 mm) of door height greater than 90 inches (2286 mm).
- G. 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] [directed by Owner].
 - 2. Furnish permanent cores to Owner for installation.

- H. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- I. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, [above accessible ceilings] [in equipment room]. Verify location with Architect.
 - 1. Configuration: Provide [one power supply for each door opening] [least number of power supplies required to adequately serve doors] with electrified door hardware.
- J. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- K. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- L. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- M. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- N. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- O. 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.

3.2 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

3.3 DOOR HARDWARE SCHEDULE

Set 01	Lobby			
2 ea	Continuous Hinge	SL18HD	628	SE
1 ea	2 Point Flush Bolt	MS1880		AR
1 ea	Deadlock	MS1850S		AR
3 ea	Mortise Cylinder	X AR cam		DO
2 ea	Permanent Core			
2 set	Push Pull Bars	1738	630	TR

2 ea	Closer	8916 SDS	689	DO
1 set	Seal & Meeting Style	By aluminum door manufacturer		
1 ea	Threshold	425 SIA x MS&ES		NG
2 ea	Door Sweep	627A		NG
1 ea	Rain Drip	16A (omit @ overhang)		NG

PROVIDE AS BID ALTERATE PRICING FOR OWNER APPROVAL

Set 01A	Lobby- DOUBLE ACTING			
2 ea	Floor Closer	BTS80 – center hung double acting	626	DO
2 ea	Bottom Rail Deadlock	MS1861	628	AR
4 ea	Mortise Cylinder	X AR cam	626	DO
2 ea	Permanent Core			
2 set	Pulls	1191-4 BTB	630	TR
2 ea	Overhead Concealed Stops	910 S series x size as required	689	DO
1 set	Meeting Style	By aluminum door manufacturer	689	DO
1 ea	Threshold	425 SIA x MS&ES prep for floor closer		NG

Set 02	Ext/Sgl			
1 ea	Continuous Hinge	SL14HD	628	SE
1 ea	Exit Device	9300 x YLC08 T	630	DO
2 ea	Permanent Core			
1 ea	Closer?/top	8916 SDS	689	DO
1 set	Seal	5050B (head & jambs)		NG
1 ea	Threshold	425 SIA x MS&ES		NG
1 ea	Door Sweep	627A		NG
1 ea	Rain Drip	16A (omit @ overhang)		NG

Set 03	Ext/Fire Room			
1 ea	Continuous Hinge	SL14HD	628	SE
1 ea	Storeroom Lockset	C880T x LC	626	DO
2 ea	Permanent Core			
1 ea	Closer/Stop	8916 SDS	689	DO
1 set	Seal	5050B (head & jambs)		NG
1 ea	Threshold	425 SIA x MS&ES		NG
1 ea	Door Sweep	627A		NG
1 ea	Rain Drip	16A (omit @ overhang)		NG

Set 03A	Ext/Drivers			
1 ea	Continuous Hinge	SL14HD	628	SE
1 ea	Classroom Lockset	C880T x LC	626	DO
2 ea	Permanent Core			
1 ea	Closer/Stop	8916 SDS	689	DO
1 set	Seal	5050B (head & jambs)		NG
1 ea	Threshold	425 SIA x MS&ES		NG
1 ea	Door Sweep	627A		NG

1 ea	Rain Drip	16A (omit @ overhang)		NG
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Set 04	Not Used			
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Set 05	Conference			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Office Lockset	C853T x LC	626	DO
2 ea	Permanent Core			
1 ea	Closer	8916 SPA	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 06	Office			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Office Lockset	C853T x LC		AR
2 ea	Permanent Core			
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 07	Storeroom/Tel			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Storeroom Lockset	C880T x LC	626	DO
2 ea	Permanent Core			
1 ea	Closer	8916 AF89P	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 07A	Storeroom			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Classroom Lockset	C870T x LC	626	DO
2 ea	Permanent Core			
1 ea	Closer	8916 AF89P	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
3 ea	Silencers	1229A		TR

Set 08	Corridor			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Exit Device	9300 x YLC08T	630	DO
2 ea	Permanent Core			
1 ea	Closer	8916 SPA	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 09	Restrooms			
3 ea	Hinges	BB5002 4.5 x 4.5	630	BO
1 ea	Latch Set	C810 x LC	626	DO
1 ea	Closer	8916 AF89P	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Mop Plate	KM050 6" x 1" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 10	Restrooms			
3 ea	Hinges	BB5002 4.5 x 4.5	630	BO
1 ea	Latch Set	C810 x LC	626	DO
1 ea	Closer	8916 SPA	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 11	Restrooms			
3 ea	Hinges (Heavy Weight)	BB5006 4.5 x 4.5	630	BO
1 ea	Push Plate	1001-3 4" x 16"	630	TR
1 ea	Pull Plate	1017-3B 4" x 16"	630	TR
1 ea	Closer	8916 AF89P	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Mop Plate	KM050 6" x 1" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 12	Janitor			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Storeroom Lockset	C880T x LC	626	DO
2 ea	Permanent Core			
1 ea	Closer	8916 AF89P	689	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Mop Plate	KM050 6" x 1" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
3 ea	Silencers	1229A		TR

Set 13	Restrooms			
3 ea	Hinges	BB5000 4.5 x 4.5 NRP	652	BO
1 ea	Privacy Set	C840 x LC	626	DO
1 ea	Kick Plate	K0050 10" x 2" LDW x B4E	630	TR
1 ea	Mop Plate	KM050 6" x 1" LDW x B4E	630	TR
1 ea	Wall Stop	1270CV	626	TR
1 set	Seal (sound dampening)	5050B (head & jambs)		NG

Set 14	Elec/Pair/Exterior			
2 ea	Continuous Hinges	SL14HD	628	SE
1 ea	Exit Device	9300 x YLC03T	630	DO
1 ea	Exit Device	9300 x exit only	630	DO
1 ea	KR Mullion	1340KR		DO
2 ea	Permanent Core			
2 ea	Closer/Stop	8916 SDS	689	DO
1 set	Seal	5050B (head & jambs)		NG
1 ea	Threshold	425 SIA x MS&ES		NG
2 ea	Door Sweep	627A		NG
1 ea	Rain Drip	16A (omit @ overhang)		NG

Set 15	Overhead Doors			
1 ea	Cylinder	As required		
	Balance of Hardware	By overhead door manufacturer		

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed curtain walls.
4. Storefront framing.
5. Interior borrowed lites.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 or the building code listed on the drawings by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.4 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 - C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
 - D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
 - E. 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.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Preconstruction adhesion and compatibility test report.
- 1.6 QUALITY ASSURANCE
- 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: GANA's "Glazing Manual."
 2. 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 labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- 1.7 WARRANTY
- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass

contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which 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: 10 years from date of Substantial Completion.

- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. 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.
- C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic -protection testing requirements in ASTM E 1996 for Wind Zone as indicated on the drawings when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
- 1.

- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
1. **Products:** Subject to compliance with requirements, as indicated on the drawings or available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **AFG Industries, Inc.; Krystal Klear.**
 - b. **Guardian Industries Corp.; Ultrawhite.**
 - c. **Pilkington North America; Optiwhite.**
 - d. **PPG Industries, Inc.; Starphire.**
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
- C. Pyrolytic-Coated, Self-Cleaning, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
1. **Products:** Subject to compliance with requirements, as indicated on the drawings or available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **AFG Industries, Inc.; Spotless Ti.**
 - b. **Cardinal Glass Industries; LoE2 Plus.**
 - c. **Pilkington North America; Activ.**
 - d. **PPG Industries, Inc.; SunClean.**
- D. Reflective-Coated Vision Glass: ASTM C 1376, coated by pyrolytic process , and complying with other requirements specified.
1. **Basis-of-Design Product:** Subject to compliance with requirements, provide as indicated on the drawings or comparable product.

2.3 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, as indicated on the drawings or approved equal.
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1. Sealing System: Dual seal.
 - 2. Spacer: Manufacturer's standard spacer material and construction

2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.5 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.
 - 3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.6 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:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. 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:
 - 1. AAMA 810.1, Type 1, 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.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. 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.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

PART 3 - EXECUTION

3.1 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. 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.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
- H. 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.

3.2 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. Apply heel bead of elastomeric sealant.

- F. 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 toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 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 toward 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 lites 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.

3.4 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.

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. 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; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 089119 FIXED LOUVERS

PART 1 GENERAL

1.01 Summary

- A. Furnish and install louvers, bird screens, blank-off panels, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.
- B. The louvers to be furnished include the following:
 - 1. Standard fixed extruded louvers.
- C. Related sections include:
 - 1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

1.02 References

- A. Air Movement and Control Association International, Inc.
 - 1. AMCA Standard 500-L-99 Laboratory Methods of Testing Louvers for Rating
 - 2. AMCA Publication 501 Application Manual for Louvers
- B. The Aluminum Association Incorporated
 - 1. Aluminum Standards and Data
 - 2. Specifications and Guidelines for Aluminum Structures
- C. American Society of Civil Engineers
 - 1. Minimum Design Loads for Buildings and Other Structures
- D. American Society for Testing and Materials
 - 1. ASTM B209
 - 2. ASTM B211
 - 3. ASTM B221
 - 4. ASTM E90-90
- E. Architectural Aluminum Manufacturers Association
 - 1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
 - 2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA TIR Metal Curtain Wall Fasteners
 - 4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels
- F. Canadian Standards Association
 - 1. CAN3-S157-M83 Strength Design in Aluminum
 - 2. S136 94 Cold Formed Steel Structural Members

1.03 Submittals

- A. Product Data
 - 1. Air flow and water entrainment performance test results.
 - 2. Material types and thickness.
- B. Shop Drawings
 - 1. Include elevations, sections and specific details for each louver.
 - 2. Show anchorage details and connections for all component parts.
 - 3. Include signed and sealed structural calculations.
- C. Samples
- D. Submit color chips for approval.

1.04 Quality Assurance

- A. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years experience in the design and manufacturing of work similar to that shown and required.
- B. Performance Requirements: Provide AMCA and BSRIA test data as required to confirm that the louvers have the specified air and water performance characteristics.
- C. Acoustical Performance: Where applicable, submit test reports to confirm that the louvers meet the specified STC and Noise Reduction requirements.
- D. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be 1/180 or 0.75 inches, whichever is less. Maximum allowable deflection for the louver blades to be 1/120 or 0.50 inch across the weak axis, whichever is less.
- E. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the state of New Jersey (or Mississauga, Ontario).
- F. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

1.05 Delivery, Storage and Handling

- A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.
- B. Storage:
 - 1. Material may be stored flat, on end or on its side.
 - 2. Material may be stored either indoors or outdoors.
 - 3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
 - 4. If stored out doors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.
- C. Handling:
 - 1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.
 - 2. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.
 - 3. Louver sections should only be lifted and carried by the jambs. Heads, sills and blades are not to be used for lifting or hoisting louver sections.

PART 2 PRODUCTS

2.01 Manufacturers

- A. The louvers and related materials herein specified and indicated on the drawings shall be as manufactured by:

Construction Specialties, Inc.	Construction Specialties, LTD.
49 Meeker Avenue	895 Lakefront Promenade
Cranford, New Jersey 07016	Mississauga, Ontario L5E 2C2
Telephone: 800-631-7379	Telephone: 888-895-8955
- B. Products equal to the C/S materials may be offered providing that the manufacturer and materials are pre-approved at least 10 working days before the bid date.

2.02 Materials

- A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
- B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

2.03 Fabrication, General

- A. Provide C/S louver models, bird screens, blank-off panels, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
- B. Louvers to be mechanically assembled using stainless steel or aluminum fasteners.
- C. Include supports, anchorage, and accessories required for complete assembly.

2.04 Louver Models

- A. C/S 4" (101.6) Deep High Performance Fixed Extruded Arch. Line Louver Model A4085
 - 1. Material: Heads, sills and jambs to be one piece structural aluminum members with integral caulking slot and retaining beads. Blades to be one piece aluminum extrusions with reinforcing bosses. Fixed Blades to be supported and lined up with heavy gauge extruded aluminum blade braces, positively interlocked to each blade and mechanically secured to aluminum structurals. Material thickness to be as follows: Heads, sills and jambs: 0.081" (2.06mm). Blades: 0.081" (2.06mm).
 - 2. AMCA Performance: A 4' x 4' unit shall conform to the following and licensed to bear the AMCA seal:

Free Area	8.65 sq. ft. (0.804 sq. m.)
Free area velocity at the point of beginning water penetration	804 FPM (245.1 m/min)
Intake Pressure drop at the point of beginning water penetration	0.12 in. H ₂ O (3.05 mm)
Exhaust pressure drop at 1000 fpm free area velocity (305 m/min)	0.18 in. H ₂ O (4.65 mm)

2.05 Finishes

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.

B. Powder Coating

- 1. All louvers shall be finished with C/S Powder Coat, custom color, a coating to be 1.5 to 3 mil. thick full strength 100% resin Fluoropolymer coating. Finish to allow zero VOCs to be emitted into facility of application. Finish to adhere to a 4H Hardness rating.
- 2. All finishing procedures shall be one continuous operation in the plant of the manufacturer. The coating shall meet or exceed all requirements of AAMA specification 2605 "Voluntary Specification for High Performance Organic Coatings on Architectural extrusions and Panels."

3. The louver manufacturer shall supply an industry standard 20-year limited warranty against failure or excessive fading of the Fluoropolymer Powder Coat finish. This limited warranty shall begin on the date of material shipment.

2.06 Bird Screens

- A. Unless otherwise indicated, all louvers to be furnished with mill finish bird or insect screens.
- B. Screens to be 5/8" (15.9mm) mesh, 0.050" (1.27mm) thick expanded and flattened aluminum bird screen secured within 0.055" (1.40mm) thick extruded aluminum frames. Frames to have mitered corners and corner locks.

PART 3 EXECUTION

3.01 Examination: Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

3.02 Installation

- A. Comply with manufacturer's instructions and recommendations for installation of the work.
- B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.
- C. Anchor louvers to the building substructure as indicated on architectural drawings.
- D. Erection Tolerances:
 1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
 2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.
- E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- F. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- G. Set units level, plumb and true to line, with uniform joints.

3.03 Protection

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.04 Adjusting and cleaning

- A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.

- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials and replace with new materials.
 - 1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating costs for each product having recycled content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. 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.

2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
 1. Minimum Base-Metal Thickness: As indicated on Drawings.
 2. Depth: As indicated on Drawings.

- C. Slip-Type Head Joints: Where indicated, provide the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above, as indicated on drawings.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) **Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.**
 - 2) **MBA Building Supplies; Slotted Deflector Track.**
 - 3) **Superior Metal Trim; Superior Flex Track System (SFT).**
 - 4) **Telling Industries; Vertical Slip Track**
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: As indicated on Drawings
- E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
 2. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
1. Configuration: hat shaped.
- H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch).
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches , wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Flat Hangers: Steel sheet, in size indicated on Drawings.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.
 - 1. Depth: As indicated on Drawings.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
 - a. Minimum Base-Metal Thickness: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: As indicated on Drawings.
 - 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
 - a. Configuration: hat shaped.

2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt.

PART 3 - EXECUTION

3.1 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. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 3. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) 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 penetrating 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.
 2. 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.
 3. 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.
 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

- F. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 3. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured and regionally extracted and manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
3. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### A. 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.

- B. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

2.3 INTERIOR GYPSUM BOARD

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. PABCO Gypsum.
 - 7. Temple-Inland.
 - 8. USG Corporation.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: As indicated on drawings.
 - 2. Long Edges: Tapered.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: As indicated on drawings .
 - 2. Long Edges: Tapered.
- E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: As indicated.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **CertainTeed Corp.; GlasRoc Sheathing.**
 - b. **Georgia-Pacific Gypsum LLC; Dens-Glass Gold.**
 - c. **National Gypsum Company; Gold Bond, e(2)XP.**
 - d. **USG Corporation; Securock Glass Mat Sheathing.**
2. **Core:** As indicated.

2.5 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CertainTeed Corp.; GlasRoc Tile Backer.**
 - b. **Georgia-Pacific Gypsum LLC; DensShield Tile Backer.**
2. **Core:** As indicated on Drawings.
3. **Mold Resistance:** ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. **American Gypsum.**
 - b. **CertainTeed Corp.**
 - c. **Georgia-Pacific Gypsum LLC.**
 - d. **Lafarge North America Inc.**
 - e. **PABCO Gypsum.**
 - f. **Temple-Inland.**
 - g. **USG Corporation.**
2. **Core:** As indicated on Drawings.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet
- B. Exterior Trim: ASTM C 1047.
1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
 2. Exterior Gypsum Soffit Board: Paper.
 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.8 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).
1. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **Accumetric LLC; BOSS 824 Acoustical Sound Sealant.**
 - b. **Grabber Construction Products; Acoustical Sealant GSC.**
 - c. **Pecora Corporation; AC-20 FTR.**
 - d. **Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.**
 - e. **USG Corporation; SHEETROCK Acoustical Sealant.**

2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board 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 panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Install 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.
 1. Aluminum Trim: Install in locations indicated on Drawings.
- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 3: Where indicated on Drawings.
 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 5. Level 5: Where indicated on Drawings .
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

- H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.
 - 2. Glazed wall tile.
 - 3. Crack isolation membrane.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 3. Product Data for Credit IEQ 4.3: For grout sealers, documentation indicating that products comply with requirements of FloorScore certification.
- C. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
 - 3. Stone thresholds.

1.3 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.

1.4 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 floor tile installation.
 - 2. Build mockup of each type of wall tile installation.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics 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.

2.2 TILE PRODUCTS

- A. Ceramic Tile: Unglazed porcelain tile.
 - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Daltile "Keystones" or comparable product by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean Corporation.
 - c. Crossville, Inc.
 - d. Dal-Tile Corporation.
 - e. Florida Tile, Inc.
 - f. Florim USA.
 - g. Interceramic.
 - h. Iris US.
 - i. Porcelanite.
 - j. Seneca Tiles, Inc.
 - 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
 - 3. Face Size: 2 by 2 inches.
 - 4. Thickness: 1/4 inch.
 - 5. Face: Plain with cushion edges.
 - 6. Dynamic Coefficient of Friction: Not less than 0.42.
 - 7. Tile Color, Glaze, and Pattern: Architect to select from full range of manufacturers selection.

8. Grout Color: Architect to select from full range of manufacturers selection.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cap: Surface bullnose, module size same as adjoining flat tile.
 - b. Base Cove: Surface bullnose, module size same as adjoining flat tile .
 - c. Wainscot Cap: Surface bullnose, module size same as adjoining flat tile .
 - d. External Corners: Surface bullnose, module size same as adjoining flat tile .
 - e. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Ceramic Tile: Glazed wall tile (field).

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Daltile "Semi-Gloss" or comparable product by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean Corporation,
 - c. Dal-Tile Corporation,
 - d. Jeffrey Court Inc,
 - e. Porcelanite,
 - f. Seneca Tiles, Inc,
2. Module Size: 2 by 2 inches.
3. Thickness: 5/16 inch.
4. Face: Plain with modified square edges or cushion edges.
5. Finish: Bright, opaque glaze.
6. Tile Color and Pattern: Architect to select from full range of manufacturers selection.
7. Grout Color: Custom Building Products - Architect to select from full range of manufacturers selection.
8. Mounting: Factory, back mounted.
9. Mounting: PregROUTED sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Wainscot Cap: Bullnose cap , module size 2 by 2 inches .
 - b. External Corners: Bullnose , same size as adjoining flat tile.
 - c. Internal Corners: Field-butteted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

C. Ceramic Tile: Glazed wall tile (accent).

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Daltile "Semi-Gloss" or comparable product by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean Corporation,
 - c. Dal-Tile Corporation,
 - d. Jeffrey Court Inc.,
 - e. Porcelanite,
 - f. Seneca Tiles, Inc.,
2. Module Size: 2 by 2 inches.
3. Thickness: 5/16 inch.
4. Face: Plain with modified square edges or cushion edges.
5. Finish: Bright, opaque glaze.
6. Tile Color and Pattern: Architect to select from full range of manufacturers selection
7. Grout Color: Custom Building Products - Architect to select from full range of manufacturers selection.
8. Mounting: Factory, back mounted.
9. Mounting: Pregrouted sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Wainscot Cap: Bullnose cap , module size 2 by 2 inches.
 - b. External Corners: Bullnose , same size as adjoining flat tile.
 - c. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 THRESHOLDS

- A. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. C-Cure; C-Cure Board 990.
- b. Custom Building Products; Wonderboard.
- c. FinPan, Inc.; ProTEC Concrete Backer Board.
- d. USG Corporation; DUROCK Cement Board.

2. Thickness: 1/4 inch.

2.5 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
 - 1. **Products:** Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Noble Company (The); Nobleseal CIS.
- C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester; 0.040-inch nominal thickness.
 - 1. **Products:** Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Compotite Corporation; Composeal Gold.

2.6 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
 - 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. Ardex Americas.
 - b. Boiardi Products Corporation; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.

- j. Merkrete Systems; Parex USA, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; H. B. Fuller Construction Products Inc.
2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 3. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.

2.7 GROUT MATERIALS

A. Standard Cement Grout: ANSI A118.6.

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. Boiardi Products Corporation; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; H. B. Fuller Construction Products Inc.

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. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver exposed-edge material.

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. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.

- C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bonsal American, an Oldcastle company; Grout Sealer.
 - b. Custom Building Products; Grout Sealer.
 - c. Jamo Inc.; Grout Sealer.
 - d. Southern Grouts & Mortars, Inc.; Grout Sealer.
 - e. Summitville Tiles, Inc.; SL-15, Invisible Seal.
 - f. TEC, H. B. Fuller Construction Products Inc.; Guard All Invisible Penetrating Sealer.
 2. Grout sealers shall comply with requirements of FloorScore certification.
 3. Grout sealers shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Small-Scale Environmental Chambers."

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.
- 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 thin set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped toward drains as indicated on drawings.

- 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 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.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of rib-backed tiles.
- 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 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.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch.
 - 2. Porcelain Tile: 1/4 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- L. Grout Sealer: Apply grout sealer to grout joints 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.
- M. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- N. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- O. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for ceilings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content..
 - 2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
- C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.

- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.

5. Perimeter moldings.

B. Qualification Data: For testing agency.

C. Product Test Reports.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

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. Acoustical 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.
- 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. 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 shown on Drawings.
- 2. 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 acoustical 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 acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 2. Suspension System: Obtain each type from single source from single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- D. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.
- E. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- F. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 ACOUSTICAL PANELS **AP-1**

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide USG Eclipse Clima Plus or comparable product by one of the following:
1. **Armstrong World Industries, Inc.**
 2. **CertainTeed Corp.**
 3. **USG Interiors, Inc.; Subsidiary of USG Corporation.**
- B. Color: White
- C. LR: Not less than 0.85 .
- D. NRC: Not less than 0.70.
- E. CAC: Not less than 35
- F. AC: N/A.
- G. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members
- H. Thickness: 3/4 inch .
- I. Modular Size: As indicated on Drawings.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. 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/C 635M.

- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- F. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- G. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.5 METAL SUSPENSION SYSTEM

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide USG Centricitee DXT Grid or comparable product by one of the following:
 - 1. **Armstrong World Industries, Inc.**
 - 2. **CertainTeed Corp.**
 - 3. **USG Interiors, Inc.; Subsidiary of USG Corporation.**

2.6 METAL EDGE MOLDINGS AND TRIM

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. **Armstrong World Industries, Inc.**
 - 2. **CertainTeed Corp.**
 - 3. **Chicago Metallic Corporation.**
 - 4. **Fry Reglet Corporation.**
 - 5. **Gordon, Inc.**
 - 6. **USG Interiors, Inc.; Subsidiary of USG Corporation.**
- B. 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. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

- A. **Products:** Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. **Pecora Corporation;** AC-20 FTR Acoustical and Insulation Sealant.
 - b. **USG Corporation;** SHEETROCK Acoustical Sealant.
2. **Acoustical Sealant for Concealed Joints:**
 - a. **Henkel Corporation;** OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. **Pecora Corporation;** AIS-919.
 - c. **Tremco, Inc.;** Tremco Acoustical Sealant.

- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical 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 acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical 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 acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- 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.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, 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.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
 - D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical 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 o.c. 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.
 - E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - F. Install acoustical 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. .For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 2. 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.
 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
 5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
- C. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. **Manufacturers:** Subject to compliance with requirements, As indicated on the drawings or approved equal:
 - a. Allstate Rubber Corp.; Stoler Industries.
 - b. Armstrong World Industries, Inc.
 - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - d. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - e. Estrie Products International; American Biltrite (Canada) Ltd.
 - f. Flexco, Inc.
 - g. Johnsonite.
 - h. Mondo Rubber International, Inc.
 - i. Musson, R. C. Rubber Co.
 - j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - k. PRF USA, Inc.
 - l. Roppe Corporation, USA.
 - m. VPI, LLC; Floor Products Division.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset)
2. Manufacturing Method: Group I (solid, homogeneous)
3. Style: Cove (base with toe) .

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches, or as indicated on Drawings.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Adhesives shall comply with 2013 California Green Building Standards Code..
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- 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.

3.2 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 practicable 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.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.3:
 - a. For carpet tile, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
 - b. For installation adhesive, documentation including printed statement of VOC content.
- C. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Type of subfloor.
 - 3. Type of installation.
 - 4. Pattern of installation.
 - 5. Pattern type, location, and direction.
 - 6. Pile direction.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Gold, 52 to 70 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 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. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 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, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Products: Subject to compliance with requirements, provide the following :

- 1. Bolyu.

- B. Color: As selected by Architect from manufacturer's full range .

- C. Pattern: On Point.

- D. Fiber Type: Avarar RE Nylon.
- E. Pile Characteristic: Textured Loop pile.
- F. Pile Thickness: .091 inches> for finished carpet tile according to ASTM D 6859.
- G. Stitches: 15 inch.
- H. Surface Pile Weight: 17 oz./sq. yd..
- I. Primary Backing/Backcoating: Manufacturer's standard composite materials .
- J. Secondary Backing: Manufacturer's standard material .
- K. Backing System: Nexterra.
- L. Size: 24 by 24 inches .
- M. Applied Soil-Resistance Treatment: Manufacturer's standard material .
- N. Antimicrobial Treatment: Manufacturer's standard material .

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. 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. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION

- 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. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- F. Installation Method: [As recommended in writing by carpet tile manufacturer] [Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive] [Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive] [Free lay; install carpet tiles without adhesive].
- G. Maintain dye lot integrity. Do not mix dye lots in same area.
- H. 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.
- I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- J. 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.
- K. Install pattern parallel to walls and borders.
- L. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, 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.
- M. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 096813

1
2 **SECTION 09 91 00 - HIGH PERFORMANCE COATINGS**

3 PART 1 - GENERAL

4 1.1 SUMMARY

5 A. Section Includes:

- 6 1. High performance industrial coatings (HPIC).
7 2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required
8 as part of a complete System specified in this Specification Section.
9 3. Minimum surface preparation requirements.

10 1.2 QUALITY ASSURANCE

11 A. Referenced Standards:

- 12 1. ASTM International (ASTM):
13 a. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
14 b. D4259, Standard Practice for Abrading Concrete.
15 c. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry
16 for Coating.
17 d. D4262, Standard Test Method for pH of Chemically Cleaned or Etched
18 Concrete Surfaces.
19 e. D4263, Standard Test Method for Indicating Moisture in Concrete by the
20 Plastic Sheet Method.
21 f. E84, Standard Test Method for Surface Burning Characteristics of
22 Building Materials.
23 2. National Association of Pipe Fabricators (NAPF):
24 a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings
25 in Exposed Locations Receiving Special External Coatings and/or
26 Special Internal Linings:
27 1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
28 2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
29 3. National Fire Protection Association (NFPA):
30 a. 101, Life Safety Code.
31 4. NSF International (NSF).
32 5. Steel Door Institute/American National Standards Institute (SDI/ANSI):
33 a. A250.10, Test Procedure and Acceptance Criteria For Prime Painted
34 Steel Surfaces for Steel Doors and Frames.
35 6. The Society for Protective Coatings (SSPC):
36 a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
37 b. SP 1, Solvent Cleaning.
38 c. SP 2, Hand Tool Cleaning.
39 d. SP 3, Power Tool Cleaning.
40 e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized
41 Steel, Stainless Steels, and Non-ferrous Metals.
42 7. The Society for Protective Coatings/NACE International (SSPC/NACE):
43 a. SP 5/NACE No. 1, White Metal Blast Cleaning.
44 b. SP 6/NACE No. 3, Commercial Blast Cleaning.
45 c. SP 7/NACE No. 4, Brush-off Blast Cleaning.
46 d. SP 10/NACE No. 2, Near-White Blast Cleaning.

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- 1 e. SP 12/NACE No. 5, Surface Preparation and Cleaning of Steel and
2 Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior
3 to Recoating.
4 f. SP 13/NACE No. 6, Surface Preparation of Concrete.
- 5 B. Qualifications:
- 6 1. Coating manufacturer's authorized representative shall provide written
7 statement attesting that applicator has been instructed on proper
8 preparation, mixing and application procedures for coatings specified.
9 2. Applicators shall have minimum of 10 years experience in application of
10 similar products on similar project.
11 a. Provide references for minimum of three (3) different projects completed
12 in last five (5) years with similar scope of work.
13 b. Include name and address of project, size of project in value (painting)
14 and contact person.
- 15 C. Miscellaneous:
- 16 1. Furnish paint through one (1) manufacturer unless noted otherwise.
17 2. Coating used in all corridors and stairways shall meet requirements of
18 NFPA 101 and ASTM E84.
- 19 D. Deviation from specified mil thickness or product type is not allowed without
20 written authorization of Engineer.
- 21 E. Material shall not be thinned unless approved, in writing, by paint
22 manufacturer's authorized representative.

23 1.3 DEFINITIONS

- 24 A. Installer or Applicator:
- 25 1. Installer or applicator is the person actually installing or applying the product
26 in the field at the Project site.
27 2. Installer and applicator are synonymous.
- 28 B. Approved Factory Finish: Finish on a product in compliance with the finish
29 specified in the Specification Section where the product is specified.
- 30 C. Corrosive Environment: Immersion in, or not more than 6 IN above, or subject
31 to condensation, spillage or splash of a corrosive material such as water,
32 wastewater, or chemical solution; or exposure to corrosive, caustic or acidic
33 agent, chemicals, chemical fumes, chemical mixture, or solutions with pH range
34 of 5 to 9.
- 35 D. Highly Corrosive Environment: Immersion in, or not more than 6 IN above, or
36 subject to condensation, spillage or splash of a highly corrosive material such
37 as water, wastewater, or chemical solution; or exposure to highly corrosive,
38 caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or
39 solutions with pH range below five (5) or above nine (9).
- 40 E. Exposed Exterior Surface:
- 41 1. Surface which is exposed to weather but not necessarily exposed to view as
42 well as surface exposed to view.
43 2. Exterior surfaces are considered corrosive environment.
44 a. The following areas are considered highly corrosive:
45 1) All chemical unloading stations and areas within 10 FT-0 IN of
46 containment areas.

-
- 1 2) All chemical unloading station containment areas.
2 3) All areas within a 6 FT radius of chemical tank vents.
- 3 F. Finished Area: An area that is listed in or has finish called for on Room Finish
4 Schedule or is indicated on Drawings to be painted.
- 5 G. Immersion Surface:
6 1. Any surface immersed in water or some other liquid.
7 2. Surface of any pipe, valve, or any other component of the piping system
8 subject to condensation including the pipe support system.
- 9 H. Paint includes the following:
10 1. High performance industrial coatings (HPIC) include: Epoxies, urethanes,
11 vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds,
12 acrylic emulsions and any other coating listed as a HPIC.
- 13 I. Surface Hidden from View: Surfaces such as those within pipe chases,
14 surfaces between top side of ceilings (including drop-in tile ceilings) and
15 underside of floor or roof structures above, surfaces under overhanging
16 walkways if over five feet above adjacent walking surfaces
- 17 J. AP: Architectural paints.
- 18 K. HPIC: High performance industrial coatings.
- 19 L. SC: Special coatings.

20 1.4 SUBMITTALS

- 21 A. Shop Drawings:
22 1. See Specification Section 01 33 00 for requirements for the mechanics and
23 administration of the submittal process.
24 2. Applicator experience qualifications.
25 a. No submittal information will be reviewed until Engineer has received
26 and approved applicator qualifications.
27 3. Product technical data including:
28 a. Acknowledgement that products submitted meet requirements of
29 standards referenced.
30 b. Manufacturer's application instructions.
31 c. Manufacturer's surface preparation instructions.
32 d. If products being used are manufactured by Company other than listed
33 {in the MATERIALS Article of this Specification Section}, provide
34 complete individual data sheet comparison of proposed products with
35 specified products including application procedure, coverage rates and
36 verification that product is designed for intended use.
37 e. Contractor's written plan of action for containing airborne particles
38 created by blasting operation and location of disposal of spent
39 contaminated blasting media.
40 f. Coating manufacturer's recommendation on abrasive blasting.
41 g. Manufacturer's recommendation for universal barrier coat.
42 h. Manufacturer's recommendation for providing temporary or
43 supplemental heat or dehumidification or other environmental control
44 measures.
45 4. Manufacturer's statement regarding applicator instruction on product use.

1 5. Certification that High Performance Coating Systems proposed for use have
2 been reviewed and approved by Senior Corrosion Specification Specialist
3 employed by the coating manufacturer.

4 B. Samples:

- 5 1. Manufacturer's full line of colors for Engineer's preliminary color selection.
6 2. After preliminary color selection by Engineer provide two (2) 3 x 5 IN
7 samples of each final color selected.

8 C. Miscellaneous Submittals:

- 9 1. See Specification Section 01 33 00 for requirements for the mechanics and
10 administration of the submittal process.
11 2. Approval of application equipment.
12 3. Applicator's daily records:
13 a. Submit daily records at end of each week in which painting work is
14 performed unless requested otherwise by Engineer's on-site
15 representative.

16 1.5 DELIVERY, STORAGE, AND HANDLING

17 A. Deliver in original containers, labeled as follows:

- 18 1. Name or type number of material.
19 2. Manufacturer's name and item stock number.
20 3. Contents, by volume, of major constituents.
21 4. Warning labels.
22 5. VOC content.

23 PART 2 - PRODUCTS

24 2.1 ACCEPTABLE MANUFACTURERS

25 A. Subject to compliance with the Contract Documents, only the following
26 manufacturers are acceptable:

- 27 1. High performance industrial coatings:
28 a. Tnemec.
29 b. [Ellis Paint Company](#)
30 c. ICI Devoe.
31 d. Carboline Protective Coatings.
32 e. Sherwin Williams.
33 f. Dampney Company, Inc.
34 g. PPG Industries/Amercoat.

35 B. Submit request for substitution in accordance with Specification Section 01 25
36 00.

- 37 1. Product VOC content will be an important factor when determining
38 acceptability of substitution.

39 2.2 MATERIALS

40 A. For unspecified materials such as thinner, provide manufacturer's
41 recommended products.

42 B. Paint Systems - General:

- 43 1. P = prime coat.

-
- 1 2. F1, F2 . . . Fn = first finish coat, second finish coat nth finish coat, color
2 as selected by Engineer.
- 3 3. If two (2) finish coats of same material are required, Contractor may, at his
4 option and by written approval from paint manufacturer, apply one (1) coat
5 equal to mil thickness of two (2) coats specified.
- 6 C. HPIC products listed in the MATERIALS Article, Paint Systems paragraph are
7 manufactured by Tnemec.
- 8 1. Products of other listed manufacturers are acceptable for use providing the
9 product is of the same generic resin, requires comparable surface
10 preparation, has comparable application requirements, meets the same
11 VOC levels or better, provides the same finish and color options and will
12 withstand the atmospheric conditions of the location where it is to be
13 applied.
- 14 D. Paint Systems (Systems not shown are not used):
- 15 1. HPIC SYSTEM #1 - Polyamidoamine Epoxy Primer with Polyamidoamine
16 Epoxy or Waterborne Acrylic Polyurethane Finish Coat(s).
- 17 a. Prime coat:
- 18 1) P1 = 1 coat, 3 mils, Series L69 Epoxoline (Polyamidoamine Epoxy)
19 or Engard 460HS Epoxy
- 20 b. Finish coat(s):
- 21 1) Interior:
- 22 a) F1 = 1 coat, 3 mils, Series L69 Epoxoline (Polyamidoamine
23 Epoxy) or Engard 460HS Epoxy.
- 24 b) F2 = 1 coat, 3 mils, Series L69 Epoxoline (Polyamidoamine
25 Epoxy) or Engard 460HS Epoxy.
- 26 2) Exterior:
- 27 a) F1 = 1 coat, 3 mils, Series L69 Epoxoline (Polyamidoamine
28 Epoxy) or Engard 460HS Epoxy.
- 29 b) F2 = 1 coat, 2.5 mils, Series 1080 Endura-Shield.
30 W.B.(Waterborne Acrylic Polyurethane) or Ellis Decade
31 Solventborne Urethane.
- 32 2. HPIC SYSTEM #2 - Zinc-Rich Urethane Primer with Polyamidoamine Epoxy
33 or Waterborne Acrylic Polyurethane Finish Coat(s).
- 34 a. Prime coat:
- 35 1) P1 = 1 coat, 3.5 mils, Series 90-97 Tneme-Zinc (Zinc-Rich
36 Urethane).
- 37 b. Finish coat(s):
- 38 1) Interior:
- 39 a) F1 = 1 coat, 6 mils, Series L69 Epoxoline (Polyamidoamine
40 Epoxy).
- 41 2) Exterior:
- 42 a) F1 = 1 coat, 6 mils, Series L69 Epoxoline (Polyamidoamine
43 Epoxy).
- 44 b) F2 = 1 coat, 2.5 mils, Series 1080 Endura-Shield
45 W.B.(Waterborne Acrylic Polyurethane).
- 46 3. HPIC SYSTEM #3 - Polyamidoamine Epoxy Primer with Polyamidoamine
47 Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
- 48 a. Prime coat:
- 49 1) P1 = 1 coat, 5 mils, Series L69 Epoxoline (Polyamidoamine Epoxy)
50 or Engard 460HS epoxy primer

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- 1 b. Finish coat(s):
2 1) Interior:
3 a) F1 = 1 coat, 5 mils, Series L69 Epoxoline (Polyamidoamine
4 Epoxy) or [Engard 460HS epoxy](#)
5 2) Exterior:
6 a) F1 = 1 coat, 2.5 mils, Series 1080 Endura-Shield W.B.
7 (Waterborne Acrylic Polyurethane) or [Ellis Decade Urethane](#)
8 4. HPIC SYSTEM #4 - Zinc-Rich Urethane Primer with Polyamidoamine Epoxy
9 or Waterborne Acrylic Polyurethane Top Coat(s).
10 a. Prime coat:
11 1) P1 = 1 coat, 2.5 mils, Series 90-97 Tneme-Zinc (Zinc-Rich
12 Urethane).
13 b. Finish coat(s):
14 1) Interior:
15 a) F1 = 1 coat, 3 mils, Series L69 Epoxoline (Polyamidoamine
16 Epoxy).
17 2) Exterior:
18 a) F1 = 1 coat, 2.5 mils, Series 1080 Endura-Shield W.B.
19 (Waterborne Acrylic Polyurethane).
20 5. HPIC SYSTEM #5 - Modified Polyamidoamine Epoxy Primer with
21 Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane or [Self-priming](#)
22 [Solventborne Urethane](#) Top Coat(s).
23 a. Prime coat:
24 1) P1 = 1 coat, 2.0 mils, Series 135 Chembuild (Modified
25 Polyamidoamine Epoxy) [Engard 460HS epoxy primer](#).
26 .
27 b. Finish coat(s):
28 1) Interior:
29 a) F1 = 1 coat, 2.5 mils, Series L69 Epoxoline (Polyamidoamine
30 Epoxy) or [Ellis Paint Company Engard 460 HS Epoxy Coating](#).
31 .
32 2) Exterior:
33 a) F1 = 1 coat, 2.0 mils, Series 1080 Endura-Shield W.B.
34 (Waterborne Acrylic Polyurethane) or [Ellis Decade Solventborne](#)
35 [Polyurethane](#) .
36 6. HPIC SYSTEM #5.1 - Cycloaliphatic Amine Epoxy Primer with Aliphatic
37 Polyester Polyurethane Top Coat(s).
38 a. Prime coat:
39 1) P1 = 1 coat, 10 mils, Series 104 H.S. Epoxy (Amine Epoxy).
40 b. Finish coat:
41 1) F1 = 1 coat, 3.0 mils, Series 290 CRU (Aliphatic Polyester
42 Polyurethane).
43 7. HPIC SYSTEM #6 - Modified Polyamidoamine Epoxy Primer with
44 Polyamidoamine Epoxy or Waterborne Acrylic Polyurethane Top Coat(s).
45 a. Prime coat:
46 1) P1 = 1 coat, 3 mils, Series 135 Chembuild (Modified
47 Polyamidoamine Epoxy) or [Ellis Engard 460HS primer](#).
48 b. Finish coat(s):
49 1) Interior:
50 a) F1 = 1 coat, 4 mils, Series L69 Epoxoline (Polyamidoamine
51 Epoxy) or [Ellis Engard 460HS Epoxy](#).

-
- 1 2) Exterior:
- 2 a) F1 = 1 coat, 3 mils, Series 1080 Endura-Shield W.B.
- 3 (Waterborne Acrylic Polyurethane) or [Ellis Decade Urethane](#).
- 4 8. HPIC SYSTEM #7 - Zinc-Rich Urethane Primer with Polyamidoamine Epoxy
- 5 or Waterborne Acrylic Polyurethane Top Coat(s).
- 6 a. Prime coat:
- 7 1) P1 = 1 coat, 2.5 mils, Series 90-97 Tneme-Zinc (Zinc-Rich
- 8 Urethane).
- 9 b. Finish coat(s):
- 10 1) Interior:
- 11 a) F1 = 1 coat, 5 mils, Series L69 Epoxoline (Polyamidoamine
- 12 Epoxy).
- 13 2) Exterior:
- 14 a) F1 = 1 coat, 3.0 mils, Series 1080 Endura-Shield W.B.
- 15 (Waterborne Acrylic Polyurethane).
- 16 9. HPIC SYSTEM #8 - Air Dry Silicone Copolymer Primer with Silicone
- 17 Copolymer Top Coat.
- 18 a. Prime coat:
- 19 1) P1 = 1 coat, 2.0 mils, Dampney Thurmalox 260C Series (Air Dry
- 20 Silicone Copolymer).
- 21 b. Finish coat:
- 22 1) Interior or exterior:
- 23 a) F1 = 1 coat, 2.0 mils, Dampney Thurmalox 260C Series (Air Dry
- 24 Silicone Copolymer).
- 25 10. HPIC SYSTEM #9 - Modified Polyamidoamine Epoxy.
- 26 a. Prime coat:
- 27 1) P1 = 1 coat, 3 mils, Series 135 Chembuild (Modified
- 28 Polyamidoamine Epoxy).
- 29 11. HPIC SYSTEM #10 - Modified Silicone Co-Polymer Primer with Modified
- 30 Silicone Co-Polymer Top Coat(s).
- 31 a. Prime coat:
- 32 1) P1 = 1 coat, 4.0 to 5.0 mils, Dampney Thurmalox 225 HD (Modified
- 33 Silicone Co-Polymer).
- 34 b. Finish coat(s):
- 35 1) F1 = 1 coat, 2.5 to 3.0 mils, Dampney Thurmalox 230C.
- 36 12. HPIC SYSTEM #11 - Zinc-Rich Aromatic Urethane Primer.
- 37 a. Prime coat:
- 38 1) P1 = 1 coat, 3.0 mils, 90-97 Tneme-Zinc (Zinc-Rich Urethane).
- 39 13. HPIC SYSTEM #12 - HDP Acrylic Polymer Primer and Top Coat.
- 40 a. Prime coat:
- 41 1) P1 = 1 coat, 2.5 mils, Series1029 Enduratone (HDP Acrylic
- 42 Polymer).
- 43 b. Finish coat:
- 44 1) Interior:
- 45 a) F1 = 1 coat, 2.5 mils, Series1029 Enduratone (HDP Acrylic
- 46 Polymer).
- 47 14. HPIC SYSTEM #13 - Modified-Acrylate Elastomer Primer and Top Coat.
- 48 a. Prime coat:
- 49 1) P1 = 1 coat, 8 mils, Series 156 Enviro-Crete (Modified-Acrylate
- 50 Elastomer).
- 51 b. Finish coat:

-
- 1 1) Exterior:
2 a) F1 = 1 coat, 8 mils, Series 156 Enviro-Crete (Modified-Acrylate
3 Elastomer).
- 4 15. HPIC SYSTEM #14 - Waterborne Modified Polyamine Epoxy Primer with
5 Specialized Acrylate Waterborne Top Coats.
6 a. Prime coat:
7 1) P1 = 1 coat, 1.5 mils, Series 151 Elasto-Grip FC (Waterborne
8 Modified Polyamine Epoxy).
9 b. Finish coat(s):
10 1) Interior:
11 a) F1 = 1 coat, 6.5 to 7.5 mils, Series 158 Bio-Lastic (Specialized
12 Waterborne Acrylate).
13 b) F2 = 1 coat, 6.5 to 7.5 mils, Series 158 Bio-Lastic (Specialized
14 Waterborne Acrylate).
- 15 16. HPIC SYSTEM #15 - Polyamidoamine Epoxy Primer with Polyamidoamine
16 Epoxy Top Coat.
17 a. Prime coat:
18 1) P1 = 1 coat, 4 mils, Series L69 Epoxoline (Polyamidoamine Epoxy)
19 or [Engard 460HS](#).
20 b. Finish coat:
21 1) Interior:
22 a) F1 = 1 coat, 6 mils, Series L69 Epoxoline (Polyamidoamine
23 Epoxy) or [Engard 460HS](#).
24 b) F2 = 1 coat, 6 mils, Series L69 Epoxoline (Polyamidoamine
25 Epoxy) or [Engard 460HS](#).
- 26 17. HPIC SYSTEM #16 - Polyamidoamine Epoxy Prime and Top Coat(s).
27 a. Prime coat:
28 1) P1 = 1 coat, 80 to 110 SF/GAL/coat, Series L69 Epoxoline
29 (Polyamidoamine Epoxy).
30 b. Finish coat(s):
31 1) Interior:
32 a) F1 = 1 coat, 175-200 SF/GAL/coat, Series L69 Epoxoline
33 (Polyamidoamine Epoxy).
- 34 18. HPIC SYSTEM #17 - Acrylic Emulsion Primer with Acrylic Emulsion Top
35 Coat(s).
36 a. Prime coat:
37 1) P1 = 1 coat, 60 to 90 SF/GAL/coat, Series 180 W.B. Tneme-Crete
38 (Acrylic Emulsion).
39 b. Finish coat(s):
40 1) Exterior:
41 a) F1 = 1 coat, 125 to 150 SF/GAL/coat, Series 180 W.B. Tneme-
42 Crete (Acrylic Emulsion).
- 43 19. HPIC SYSTEM #18 - Modified Alkyd Primer with HDP Acrylic Polymer Top
44 Coat(s).
45 a. Prime coat:
46 1) P1 = 1 coat, 2.5 mils, Series V10 Tnemec Primers (Modifed Alkyd).
47 b. Finish coat(s):
48 1) Interior or exterior:
49 a) F1 = 1 coat, 2.5 mils, Series 1029 Enduratone (HDP Acrylic
50 Polymer).

-
- 1 b) F2 = 1 coat, 2.5 mils, Series 1029 Enduratone (HDP Acrylic
2 Polymer).
- 3 20. HPIC SYSTEM #19 - Polyamidoamine Epoxy Coating.
- 4 a. Prime coat:
- 5 1) P1 = 1 coat, 5 mils, Series L69 Epoxoline (Polyamidoamine Epoxy).
- 6 21. HPIC SYSTEM #21 - Modified Polyamidoamine Epoxy.
- 7 a. Prime coat:
- 8 1) P1 = 1 coat, 5 mils, 135-1243 Chembuild (Modified Polyamidoamine
9 Epoxy).
- 10 22. HPIC SYSTEM #22 - Modified Polyamine Epoxy Primer with Modified
11 Polyurethane Top Coat(s).
- 12 a. Prime coat:
- 13 1) P1 = 1 coat, 16 mils, Series 22 Pota-Pox 100 (Modified Polyamine
14 Epoxy).
- 15 b. Finish coat(s):
- 16 1) Interior:
- 17 a) F1 = 1 coat, 25 mils, Series 264 Elasto-Shield (Modified
18 Polyurethane).
- 19 b) F2 = 1 coat, 25 mils, Series 264 Elasto-Shield (Modified
20 Polyurethane).
- 21 23. HPIC SYSTEM #23 - Zinc-Rich Urethane Potable Water Approved Primer
22 with Polyamine Epoxy Potable Water Approved Top Coats.
- 23 a. Prime coat:
- 24 1) P1 = 1 coat, 3 mils, Series 91 H₂O Hydro-Zinc (Zinc-Rich Urethane).
- 25 b. Finish coat(s):
- 26 1) Interior:
- 27 a) F1 = 1 coat, 25 mils, Series 22 Pota-Pox 100 (Modified
28 Polyamine Epoxy).
- 29 24. HPIC SYSTEM #24 - Vinyl Ester Primer with Vinyl Ester Top Coat.
- 30 a. Prime coat:
- 31 1) P1 = 1 coat, 17 mils, Series 120-5002 Vinester (Vinyl Ester).
- 32 b. Finish coat:
- 33 1) F1 = 1 coat, 17 mils, Series 120-5001 Vinester (Vinyl Ester).
- 34 25. HPIC SYSTEM #27 - Waterborne Acrylic Emulsion Prime and Top Coats.
- 35 a. Prime coat:
- 36 1) P1 = 1 coat, 80 to 110 SF/GAL/coat, Series 180, W.B. Tneme-Crete
37 (Acrylic Emulsion).
- 38 b. Finish coat:
- 39 1) Exterior:
- 40 a) F1 = 1 coat, 175 to 200 SF/GAL/coat, Series 180, W.B. Tneme-
41 Crete (Acrylic Emulsion).
- 42 26. HPIC SYSTEM #29 - Waterborne Epoxy-Amine Adduct Primer and Top
43 Coat.
- 44 a. Prime coat:
- 45 1) P1 = 1 coat, 4 mils, Series 287 Enviro-Tread (Waterborne Epoxy-
46 Amine Adduct).
- 47 b. Finish coat:
- 48 1) Interior:
- 49 a) F1 = 1 coat, 4 mils, Series 287 Enviro-Tread (Waterborne
50 Epoxy-Amine Adduct).

-
- 1 27. HPIC SYSTEM #31 - Polyamidoamine Epoxy Primer and Intermediate Coat
2 with Waterborne Polyester Polyurethane Top Coat with Glass Beads mixed
3 in for slip resistance.
4 a. Prime coat:
5 1) P1 = 4 mils, Series L69 Epoxoline (Polyamidoamine Epoxy).
6 b. Finish coats:
7 1) Exterior and interior:
8 a) F1 = 4 mils, Series L69 Epoxoline (Polyamidoamine Epoxy).
9 b) F2 = 3 mils minimum (thickness as required to cover glass
10 beads), Series 291 CRU (Waterborne Polyester Polyurethane).
11 c. Slip resistance:
12 1) Blend coarse glass beads into first finish coat (F1) at rate required to
13 provide a medium slip resistant texture.
14 a) Refer to accepted mock-up panel.
15 2) Apply second finish coat (F2) at minimum 3 mil DFT.
16 a) Apply additional coats of F2 product as required to achieve the
17 non-slip texture per the accepted mock-up panel.
18 d. Glass beads: TNEMEC Product #211-212 Coarse Glass Beads.
- 19 28. HPIC SYSTEM #32 - Waterborne Cementitious Acrylic Patching
20 Compound/Filler with Polyamidoamine Epoxy Top Coat.
21 a. Patching/filling coat:
22 1) P/F1 = 1 coat, 60 to 80 SF/GAL/coat, Series 130 Envirofill
23 (Waterborne Cementitious Acrylic).
24 b. Finish coat:
25 1) Interior:
26 a) F1 = 1 coat, 175 to 200 SF/GAL/coat, Series L69 Epoxoline
27 (Polyamidoamine Epoxy).
28 b) F2 = 1 coat, 175 to 200 SF/GAL/coat, Series L69 Epoxoline
29 (Polyamidoamine Epoxy).
- 30 29. HPIC SYSTEM #33 - Waterborne Vinyl Acrylic Primer with Water-base
31 Acrylic-Emulsion Top Coat.
32 a. Prime coat(s):
33 1) P1 = 1 coat, 2.0 mils, Series 51-792 PVA Sealer.
34 b. Finish coat(s):
35 1) Interior and exterior:
36 a) F1 = 1 coat, 2.5 mils, Series 6 Tneme-Cryl.
- 37 30. HPIC SYSTEM #34 - Polyamidoamine Epoxy Primer with Polyamidoamine
38 Epoxy Top Coat (with silica sand broadcast for slip resistance).
39 a. Prime coat:
40 1) P1 = 1 coat, 5 mils, Series L69 Epoxoline II.
41 b. Slip resistance:
42 1) Blend dry, washed 30 to 50 mesh silica sand into first finish coat
43 (F1) at rate required to provide a {light} {medium} {heavy} slip
44 resistant finish.
45 c. Finish coat:
46 1) F1 = 1 coat, 4 mils, Series L69 Epoxoline II.
47 2) F2 = 1 coat, Series L69 Epoxoline II.
48 a) F2 coat mil thickness is to be as required to achieve non-slip
49 texture specified.
- 50 31. HPIC SYSTEM #35 - Polyamine Novolac Epoxy Primer with Polyamine
51 Novolac Epoxy Top Coat.

-
- 1 a. Prime coat:
- 2 1) P1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-
- 3 Glaze.
- 4 2) P1 (vertical surface) = 1 coat, 8 to 10 mils, Series 282 Tneme-Glaze.
- 5 b. Finish coat:
- 6 1) F1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-
- 7 Glaze.
- 8 2) F1 (vertical surface) = 1 coat, 8 to 10 mils, Series 282 Tneme-Glaze.
- 9 32. HPIC SYSTEM #36 - Epoxy Modified Surfacer/Filler with Polyamine
- 10 Novolac Epoxy Top Coats.
- 11 a. Filler/surfacer coat:
- 12 1) Filler = 1 coat, 0.0625 IN thick, Series 218 Mortar Clad.
- 13 b. Prime coat:
- 14 1) P1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-
- 15 Glaze.
- 16 2) P1 (vertical surface) = 1 coat, 6 to 8 mils, Series 282 Tneme-Glaze.
- 17 c. Finish coat:
- 18 1) F1 (horizontal surface) = 1 coat, 10 to 12 mils, Series 282 Tneme-
- 19 Glaze.
- 20 2) F1 (vertical surface) = 1 coat, 6 to 8 mils, Series 282 Tneme-Glaze.
- 21 33. HPIC SYSTEM #37 - Modified Polyamine Epoxy Primer with Modified
- 22 Aliphatic Amine Epoxy Mortar Intermediate Coat and Modified Polyamine
- 23 Epoxy Top Coat(s) - (Over New Concrete).
- 24 a. Prime coat:
- 25 1) P1 = 1 coat, 6 mils, Series 201 Epoxoprime (Modified Polyamine
- 26 Epoxy).
- 27 b. Intermediate coat:
- 28 1) I1 = 1 coat, 1/8 IN or 125 mils, Series 434 Perma-Shield H₂S
- 29 (Modified Aliphatic Amine Epoxy Mortar).
- 30 c. Finish coat:
- 31 1) F1 = 1 coat, 20 mils, Series 435 Perma-Glaze (Modified Polyamine
- 32 Epoxy).
- 33 34. HPIC SYSTEM #38 - Modified Polyamine Epoxy Primer with Epoxy
- 34 Modified Mortar Filler/Surfacer Repair Coat with Modified Aliphatic Amine
- 35 Epoxy Mortar Intermediate Coat and Modified Polyamine Epoxy Top
- 36 Coat(s) - (Over Existing Concrete).
- 37 a. Prime coat - for exposed reinforcing steel (when applicable):
- 38 1) P1 = Prime all exposed reinforcing, 1 coat, 4 mils, Series L69
- 39 Epoxoline (Polyamidamine Epoxy).
- 40 b. Filler/surfacer (for voids over 1/4 IN in depth):
- 41 1) Filler/surfacer: 1 coat, thickness as required to patch damaged area
- 42 but not to exceed manufacturer's recommended thickness, Series
- 43 219 Mortar Cast (Water Based Epoxy Modified Cement).
- 44 c. Filler/surfacer (for voids up to 1/4 IN in depth):
- 45 1) Filler/surfacer: 1 coat, thickness as required to patch damaged area
- 46 but not to exceed 1/4 IN, Series 218 Mortar Clad (Epoxy Modified
- 47 Mortar).
- 48 d. Prime coat:
- 49 1) P1 = 1 coat, 6 mils, Series 201 Epoxoprime (Modified Polyamine
- 50 Epoxy).
- 51 e. Intermediate coat:

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- 1 1) I1 = 1 coat, 1/8 IN or 125 mils, Series 434 Perma-Shield H₂S
2 (Modified Aliphatic Amine Epoxy Mortar).
3 f. Finish coat:
4 1) F1 = 1 coat, 20 mils, Series 435 Perma-Glaze (Modified Polyamine
5 Epoxy).
6 35. AP SYSTEM #39 - Architectural Paints (AP).
7 a. Cross Linked Acrylic, PPG Manor Hall "Timeless" Series.
8 b. Prime coat:
9 1) P1 = 1 coat, 3 mils, Interior PVA Drywall Primer.
10 c. Finish coat:
11 1) Interior:
12 a) F1 = 1 coat, 1.5 to 2.5 mils, PPG Manor Hall "Timeless" Series,
13 Pearl finish.
14 b) F2 = 1 coat, 1.5 to 2.5 mils, PPG Manor Hall "Timeless" Series,
15 Pearl finish as needed for complete coverage.
16 36. SC SYSTEM #40 - Special Coatings (SC).
17 a. Water-based coating having pigmented resin particles suspended in an
18 aqueous solution.
19 b. Prime coat:
20 1) For new gypsum board surfaces:
21 a) P1 = Zo-Cryl Sealer 92.
22 2) For new concrete and concrete masonry surfaces:
23 a) For unfilled concrete and concrete masonry surfaces:
24 (1) Zo-Cryl Sealer 92.
25 (a) P1 = 1 coat, 60-80 SF/GAL, Series 54-562 Fine Masonry
26 Filler (Modified Epoxy).
27 b) For filled concrete and concrete masonry surfaces.
28 (1) Zo-Prime Block Filler 96.
29 (a) P2 = Z95 Primer.
30 c. Finish coat:
31 1) For new gypsum board surfaces:
32 a) F1 = Zolatone water-based coating.
33 (1) Color to be selected by Engineer.
34 2) For new unfilled concrete and concrete masonry surfaces:
35 a) F1 = Zolatone water-based coating.
36 (1) Color to be selected by Engineer.
37 3) For new filled concrete and concrete masonry surfaces:
38 a) F1 = Zolatone water-based coating.
39 (1) Color to be selected by Engineer.
40 37. SYSTEM #41 - Touch-up of galvanized surfaces not requiring a top coat.
41 a. Refer to Specification Section 05 50 00.
42 38. SYSTEM #42 - Alkyd wood stain with water-based polyurethane varnish top
43 coats.
44 a. Apply washcoat uniformly to wood at manufacturer's recommended
45 application rate.
46 b. Wood stain: Color to be selected.
47 c. First coat of water-based polyurethane varnish: Gloss.
48 d. Second coat of water-based polyurethane varnish: Satin.
49 e. Third coat of water-based polyurethane varnish: Satin.
50 39. HPIC SYSTEM #43 - Polyamidoamine Epoxy Primer with Polyamidoamine
51 Epoxy Top Coat.

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- 1 a. Prime coat:
2 1) P1 = 1 coat, 2.5 mils, Series L69 Epoxoline (Polyamidoamine
3 Epoxy).
4 b. Finish coat:
5 1) Interior:
6 a) F1 = 1 coat, 3 mils, Series L69 Epoxoline (Polyamidoamine
7 Epoxy).
8 40. HPIC SYSTEM #44 - Hydrophobic Aromatic Moisture-Cured Polyurethane
9 Primer with Hydrophobic Aromatic Moisture-Cured Polyurethane Top
10 Coat(s).
11 a. Prime coat:
12 1) P1 = 1 coat, 5 mils, Series 446 Perma-Shield-MCU (Hydrophobic
13 Aromatic Moisture-Cured Polyurethane).
14 b. Finish coat(s):
15 1) F1 = 1 coat, 8 mils, Series 446 Perma-Shield-MCU.
16 2) F2 = 1 coat, 8 mils, Series 446 Perma-Shield-MCU.

17 PART 3 - EXECUTION

18 3.1 ITEMS TO BE PAINTED

- 19 A. General:
20 1. Paint the following surfaces in a corrosive or highly corrosive area, whether
21 exposed to view or not:
22 a. Concrete and/or concrete masonry units.
23 b. Conduit.
24 c. Ducts.
25 d. Galvanized metal surfaces.
- 26 B. Exposed Exterior Surfaces including:
27 1. Smooth face concrete walls, columns, beams, equipment supports,
28 equipment pads, pipe supports and concrete slabs.
29 2. Piping, valves, fittings, and hydrants except when covered by pipe jacketing
30 and supports.
31 3. Ductwork and supports.
32 4. Conduit, device boxes, junction boxes and covers, pull boxes and covers
33 and supports when attached to a surface required to be painted or to a
34 prefinished surface.
35 5. Miscellaneous ferrous metal surfaces.
36 6. Hollow metal doors and frames and window frames.
37 7. Steel pipe bollards (not galvanized).
38 8. Steel lintels.
39 9. Steel components of concrete lintels (plain or galvanized).
40 a. Steel components shall be completely painted (with both prime and
41 finish coats) prior to installing in the wall.
42 10. Exposed wood.
43 11. Structural steel.
44 12. Steel joists (including bridging).
45 13. Copper and brass surfaces.

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- 1 14. External and internal surfaces of digester covers whether sealed from direct
2 exposure of outside atmosphere or digester atmosphere or not, and
3 associated equipment.
4 a. Internal surfaces include trusses and other inside surfaces.
5 15. Gas appliance flue vents and cast iron pipe plumbing vents.

6 C. Interior Finished Areas:

- 7 1. Refer to Room Finish Schedule on Drawings.
8 2. If room is scheduled in the Room Finish Schedule, the space is considered
9 to be a finished area, therefore, paint all appurtenant surfaces within the
10 space unless specifically noted not to be painted in the Contract
11 Documents.
12 a. If walls are not required to be painted, appurtenant concrete surfaces
13 are not required to be painted unless specifically noted otherwise.
14 b. Appurtenant surfaces include:
15 1) Concrete columns, equipment pads, pipe supports, and equipment
16 supports, underside of overhead concrete slabs which are exposed,
17 semi-exposed or concealed from view but still exposed to the
18 adjacent atmosphere.
19 2) Piping, valves, fittings and hydrants except when covered by pipe
20 jacketing and supports.
21 a) All bituminous coated ductile iron pipe to have coating
22 completely removed prior to painting.
23 3) Miscellaneous ferrous metal surfaces.
24 4) Steel lintels.
25 5) Steel components of concrete lintels (plain or galvanized).
26 a) Steel components shall be completely painted (with both prime
27 and finish coats) prior to installing in the wall.

28 D. Surfaces in Areas Not Considered Finished:

- 29 1. Paint following surfaces in areas not considered as finished area:
30 a. Piping, valves, fittings, and hydrants except when covered by pipe
31 jacketing and supports.
32 b. Miscellaneous ferrous metal surfaces.
33 c. Steel lintels.
34 d. Steel components of concrete lintels (plain or galvanized).
35 1) Steel components shall be completely painted (with both prime and
36 finish coats) prior to installing in the wall.
37 e. Inside and outside of ferrous metal tankage.
38 f. Hollow metal doors and frames {and borrowed light window frames}.

39 3.2 ITEMS NOT TO BE PAINTED

- 40 A. General: Do not paint items listed in this Article unless specifically noted in the
41 Contract Documents to be painted.
42 B. Items with Approved Factory Finish: These items may require repair of
43 damaged painted areas or painting of welded connections.
44 C. Electrical Equipment:
45 1. Do not field paint electrical equipment except where painting is specifically
46 stated elsewhere in these Contract Documents, or where the equipment is
47 subject to a corrosive environment and is specifically noted to be painted.

1 D. Other Items:

- 2 1. Stainless steel surfaces except:
- 3 a. Piping where specifically noted to be painted.
- 4 b. Banding as required to identify piping.
- 5 2. Aluminum surfaces except:
- 6 a. Where specifically shown in the Contract Documents.
- 7 b. Where in contact with concrete.
- 8 c. Where in contact with dissimilar metals.
- 9 3. Fiberglass surfaces except:
- 10 a. Fiberglass piping where specifically noted to be painted.
- 11 b. Piping supports where specifically noted to be painted.
- 12 4. Interior of pipe, ductwork, and conduits.
- 13 5. Moving parts of mechanical and electrical units where painting would
- 14 interfere with the operation of the unit.
- 15 6. Code labels and equipment identification and rating plates.
- 16 7. Concealed surfaces of precolored masonry.
- 17 8. Structural steel or steel deck required to be fireproofed.
- 18 9. Clad aluminum, clad steel, anodized aluminum, PVDF coated aluminum
- 19 and PVDF coated steel.
- 20 10. Prefinished wood doors. Prefinished wood trim.
- 21 a. Provide touch-up painting to damaged areas of prefinished surfaces.
- 22 11. Steel deck, unless specifically noted to be painted in these Contract
- 23 Documents.
- 24 12. Standing seam metal roof, fascia, trim, and roof accessories.
- 25 13. Contact surfaces of friction-type connections.
- 26 14. Metal soffit.
- 27 15. Galvanized steel items, unless specifically noted to be painted.
- 28 16. Bituminous coated ductile iron pipe.
- 29 a. See the ITEMS TO BE PAINTED Article, Interior Finished Areas
- 30 paragraph of this Specification Section.

31 3.3 SCHEDULE OF ITEMS TO BE PAINTED AND PAINTING SYSTEMS

32 A. Concrete:

- 33 1. Interior cast-in-place and interior precast surfaces (other than prefinished
- 34 panels):
- 35 SYSTEM #15.
- 36 a. Includes equipment bases, pads, walls, beams, slabs, columns, ceilings,
- 37 pedestals, pilasters, etc.
- 38 2. Exterior cast-in-place and exterior precast surfaces (other than prefinished
- 39 panels) and exterior cement plaster surfaces, in areas indicated on the
- 40 Drawings to be painted: SYSTEM #13.

41 B. Wood:

- 42 1. Interior stain and varnish: SYSTEM #42.

43 C. Steel:

- 44 1. Structural:
- 45 a. Immersion or non-immersion surfaces subject to highly corrosive
- 46 environment: SYSTEM #24.
- 47 b. Immersion surfaces subject to corrosive environment and not requiring
- 48 NSF approval: SYSTEM #2.

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- 1 c. Non-immersion surfaces subject to corrosive environment: SYSTEM
2 #7.
- 3 d. All other surfaces (non-corrosive dry environment): SYSTEM #1.
- 4 2. Joists:
- 5 a. Exposed: SYSTEM #6.
- 6 b. Above lay-in acoustical or suspended GWB ceiling: SYSTEM #9.
- 7 D. Miscellaneous ferrous metals (non-corrosive dry environment): SYSTEM #1.
- 8 1. Not for coating galvanized steel, steel (hollow metal) doors, steel (hollow
9 metal) door and window frames, and products with approved factory
10 finishes.
- 11 E. Ferrous metals subject to corrosive environment: SYSTEM #2.
- 12 1. Includes ferrous metal components of equipment located in corrosive
13 environments such as bar screens, grit washers, wetted parts of aerobic
14 digester covers, final clarifier covers and mechanisms, sluice gates, slide
15 gates, trickling filter mechanisms, bare steel handrails and guardrails,
16 piping, stairs, tank or equipment bridges, pumps, and similar items.
- 17 2. Does not include items subject to contact with potable water.
- 18 F. Ferrous metals subject to highly corrosive environment: SYSTEM #35.
- 19 1. Includes ferrous metal components of equipment located in highly corrosive
20 environments such as bar screens, grit washers, wetted parts of anaerobic
21 digester covers, primary clarifier covers and mechanisms, sluice gates, slide
22 gates, trickling filter mechanisms, piping, tank or equipment bridges, pumps
23 and similar items.
- 24 2. Does not include items subject to contact with potable water.
- 25 G. Galvanized Metals:
- 26 1. Field touch-up where top coat is required: SYSTEM #3, prime and first
27 finish coat only.
- 28 a. Prime paint only the damaged area.
- 29 2. Assembled galvanized steel items: SYSTEM #3.
- 30 3. Field touch-up of galvanized surfaces not requiring a finish top coat:
31 SYSTEM #41.
- 32 a. Paint only damaged areas.
- 33 4. Galvanized pipe bollards: SYSTEM #3.
- 34 H. Steel (hollow metal) doors and frames {and window frames} primed in the
35 factory in accordance with SDI/ANSI A250.10.
- 36 1. For doors and frames in non-corrosive environments: SYSTEM #5.
- 37 2. For doors and frames in corrosive or highly corrosive environments:
38 SYSTEM #5.1.
- 39 a. Specifically including all chemical room door openings having fiberglass
40 reinforced plastic doors with hollow metal frames.
- 41 I. Steel equipment with existing paint coating or factory-applied prime or finish
42 coating not complying with this Specification Section: SYSTEM #5.
- 43 1. Includes equipment specifically indicated in the Contract Documents to be
44 painted.
- 45 2. Factory-applied coats to remain.
- 46 J. Non-ferrous metals (except galvanized): SYSTEM #3.

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- 1 1. Includes copper, brass, aluminum and aluminum flashing specifically
2 indicated on the Drawings to be painted.
- 3 K. Plastic Surfaces:
- 4 1. PVC, FRP, and CPVC surfaces: SYSTEM #3.
5 a. Includes tankage and piping.
- 6 L. Electrical Conduit:
- 7 1. Galvanized: SYSTEM #3.
8 2. PVC coated: SYSTEM #3.
- 9 M. Pipe, Valves, and Fittings:
- 10 1. Bare steel pipe bollards: SYSTEM #2.
11 2. Steel, cast-iron, and uncoated ductile iron: SYSTEM #2.
12 3. Stainless steel: SYSTEM #1.
13 4. Brass and bronze: SYSTEM #3.
14 5. Steel aeration piping: SYSTEM #8.
- 15 N. Pipe and duct insulation: SYSTEM #12.
- 16 O. Aluminum buried in concrete, between dissimilar metals and dissimilar
17 materials: SYSTEM #19.
- 18 P. Aluminum colored pipe thread touch-up, and aluminum colored finish where top
19 coat is not required: SYSTEM #21.
20 1. Not for coating aluminum material.
- 21 Q. Steel pipe, ducts, and equipment subject to maximum high temperatures of 400
22 DegF:
23 SYSTEM #8.
- 24 R. Emergency generator engine exhaust piping: SYSTEM #10.
- 25 S. Interior gypsum board :
26 SYSTEM #14.
- 27 T. Field painting of fusion bonded epoxy coated piping, valves, couplings, etc.:
28 SYSTEM #43.

29 3.4 PREPARATION

- 30 A. General:
- 31 1. Verify that atmosphere in area where painting is to take place is within paint
32 manufacturer's acceptable temperature, humidity and sun exposure limits.
33 a. Provide temporary heating, shade and/or dehumidification as required to
34 bring area within acceptable limits.
35 1) Provide temporary dehumidification equipment properly sized to
36 maintain humidity levels required by paint manufacturer.
37 2) Provide clean heat with heat exchanger type equipment sufficient in
38 size to maintain temperature on a 24 HR basis.
39 a) Vent exhaust gases to exterior environment.
40 b) No exhaust gases shall be allowed to vent into the space being
41 painted or any adjacent space.
- 42 2. Prepare surfaces to be painted in accordance with coating manufacturer's
43 instructions and this Specification Section unless noted otherwise in this
44 Specification Section.

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- 1 a. Where discrepancy between coating manufacturer's instructions and
2 this Specification Section exists, the more stringent preparation shall be
3 provided unless approved otherwise, in writing, by the Engineer.
- 4 3. Remove all dust, grease, oil, compounds, dirt and other foreign matter
5 which would prevent bonding of coating to surface.
- 6 4. Adhere to manufacturer's recoat time surface preparation requirements.
- 7 a. Surfaces that have exceeded coating manufacturer's published recoat
8 time and/or have exhibited surface chalking shall be prepared prior to
9 additional coating in accordance with manufacturer's published
10 recommendations.
- 11 1) Minimum SSPC SP 7/NACE No. 4 unless otherwise approved by
12 Engineer.
- 13 B. Protection:
- 14 1. Protect surrounding surfaces not to be coated.
- 15 2. Remove and protect hardware, accessories, plates, fixtures, finished work,
16 and similar items; or provide ample in-place protection.
- 17 C. Prepare and paint before assembly all surfaces which are inaccessible after
18 assembly.
- 19 D. Wood:
- 20 1. Sandpaper smooth, then dust.
- 21 2. Seal all knots, pitch and resinous sapwood after priming coat has dried.
- 22 3. Putty nail holes and minor defects to match wood color.
- 23 E. Ferrous Metal:
- 24 1. Prepare ductile iron pipe in accordance with pipe manufacturer's
25 recommendations and NAPF.
- 26 a. All piping, pumps, valves, fittings and any other component used in the
27 water piping system that requires preparation for painting shall be
28 prepared in accordance with requirements for immersion service.
- 29 1) Pipe: NAPF 500-03-04.
- 30 2) Fittings: NAPF 500-03-05
- 31 b. Prepare all areas requiring patch painting in accordance with
32 recommendations of manufacturer and NAPF.
- 33 c. Remove bituminous coating per piping manufacturer, paint
34 manufacturer and NAPF recommendations.
- 35 1) The most stringent recommendations shall apply.
- 36 2. Complete fabrication, welding or burning before beginning surface
37 preparation.
- 38 a. Chip or grind off flux, spatter, slag or other laminations left from welding.
- 39 b. Remove mill scale.
- 40 c. Grind smooth rough welds and other sharp projections.
- 41 3. Solvent clean in accordance with SSPC SP 1 or detergent and low-pressure
42 water clean in accordance with SSPC SP 12/NACE No. 5 all surfaces
43 scheduled to receive additional SSPC surface preparation.
- 44 4. Surfaces subject to corrosive or highly corrosive environment and all
45 surfaces subject to immersion service:
- 46 a. Near-white blast clean in accordance with SSPC SP 10/NACE No. 2.
- 47 5. All interior and exterior structural steel not included in corrosive, highly
48 corrosive or immersion service surfaces:

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- 1 a. Minimum commercial blast clean in accordance with SSPC SP 6/NACE
2 No. 3.
- 3 6. Surfaces subject to high temperatures.
- 4 a. Heat in excess of 600 DegF: SSPC SP 10/NACE No. 2.
- 5 b. Heat in excess of 200 DegF but less than 600 DegF: SSPC SP 6/NACE
6 No. 3.
- 7 7. Surfaces of steel joists and steel trusses:
- 8 a. Commercial blast clean the major portion of the truss in accordance with
9 SSPC SP 6/NACE No. 3.
- 10 b. Power tool or hand tool clean tight connection areas and other difficult to
11 access areas in accordance with SSPC SP 2 or SSPC SP 3.
- 12 8. Steel surfaces scheduled to receive SYSTEM #24 or #35:
- 13 a. White metal blast clean in accordance with SSPC SP 5/NACE No. 1.
- 14 b. Provide 2-1/2 to 3 mil anchor profile for SYSTEMS #24 and #35.
- 15 9. All fusion bonded epoxy coated surfaces identified to be field painted:
- 16 a. Remove all traces of gloss finish by sanding or by abrasive brush
17 blasting.
- 18 b. Clean surface after removing gloss finish to remove sanding or blasting
19 residue.
- 20 10. Restore surface of field welds and adjacent areas to original surface
21 preparation.
- 22 11. Black iron piping: Remove surface varnish by solvent or waterjet and
23 detergent cleaning or brush-off blast cleaning in accordance with SSPC SP
24 7/NACE No. 4.
- 25 F. Hollow Metal:
- 26 1. Clean in accordance with SSPC SP 1 or SSPC SP 12/NACE No. 5 and in
27 accordance with hollow metal manufacturer.
- 28 G. Galvanized Steel and Non-ferrous Metals:
- 29 1. Solvent clean in accordance with SSPC SP 1 followed by brush-off blast
30 clean in accordance with SSPC SP 16 to remove zinc oxide and other
31 foreign contaminants.
- 32 a. Provide uniform 1 mil profile surface.
- 33 H. Abrasive blast clean the following equipment or surfaces regardless of previous
34 finish, if any.
- 35 I. Gypsum Wallboard {and Abuse Resistant Panels}:
- 36 1. Repair minor irregularities left by finishers.
- 37 2. Avoid raising nap of paper face on gypsum wallboard.
- 38 3. Verify moisture content is less than 8 percent before painting.
- 39 4. {Provide all special preparation required for SC application.}
- 40 J. Concrete:
- 41 1. Cure for minimum of 28 days.
- 42 2. Verify that concrete surfaces have been cleaned and that voids have been
43 patched in accordance with Specification Section 03 31 32.
- 44 a. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
- 45 3. Mechanically abrade concrete surfaces in accordance with ASTM D4259 as
46 recommended by coating manufacturer.
- 47 4. Abrasive blast concrete surfaces in accordance with SSPC SP 13/NACE
48 No. 6 to provide profile recommended by coatings manufacturer.

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- 1 5. Test pH of surface to be painted in accordance with ASTM D4262.
2 a. If surface pH is not within coating manufacturer's required acceptable
3 range, use methods acceptable to coating manufacturer as required to
4 bring pH within acceptable range.
5 b. Retest pH until acceptable results are obtained.
6 6. Verify that moisture content of surface to be painted is within coating
7 manufacturer's recommended acceptable limits.
8 a. Test moisture content of surface to be coated in accordance with ASTM
9 D4263.
10 b. After remedial measures have been taken to lower or raise moisture
11 content, retest surface until acceptable results are obtained.
- 12 K. Preparation by Abrasive Blasting:
13 1. All abrasive-blasted ferrous metal surfaces shall be inspected {and
14 approved in writing by NACE certified coatings inspector} immediately prior
15 to application of paint coatings.
16 a. Inspection shall be performed to determine cleanliness and profile depth
17 of blasted surfaces and to certify that surface has been prepared in
18 accordance with these Specifications.
19 2. Schedule the abrasive blasting operation so blasted surfaces will not be wet
20 after blasting and before painting.
21 3. Perform additional blasting and cleaning as required to achieve surface
22 preparation required.
23 a. Prior to painting, reblast surfaces allowed to set overnight and surfaces
24 that show rust bloom.
25 b. Surfaces allowed to set overnight or surfaces which show rust bloom
26 prior to painting shall be reinspected {and approved by NACE certified
27 coatings inspector} prior to paint application.
28 4. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils
29 unless required otherwise by coating manufacturer.
30 5. Provide compressed air for blasting that is free of water and oil.
31 a. Provide accessible separators and traps.
32 6. Confine blast abrasives to area being blasted.
33 a. Provide shields of polyethylene sheeting or other such barriers to
34 confine blast material.
35 b. Plug pipes, holes, or openings before blasting and keep plugged until
36 blast operation is complete and residue is removed.
37 7. Protect nameplates, valve stems, rotating equipment, motors and other
38 items that may be damaged from blasting.
39 8. Reblast surfaces not meeting requirements of these Specifications.
40 9. Abrasive blasting media may be recovered, cleaned and reused providing
41 Contractor submits, for Engineer's review, a comprehensive recovery plan
42 outlining all procedures and equipment proposed in reclamation process.
43 10. Properly dispose of blasting material contaminated with debris from blasting
44 operation not scheduled to be reused.
- 45 L. All Plastic Surfaces and Non-Ferrous Surfaces Except Galvanized Steel:
46 1. Sand using 80-100 grit sandpaper to scarify surfaces.

47 3.5 APPLICATION

48 A. General:

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- 1 1. Thin, mix and apply coatings by brush, roller, or spray in accordance with
2 manufacturer's installation instructions.
 - 3 a. Application equipment must be inspected and approved in writing by
4 coating manufacturer.
 - 5 b. Hollow metal shall be spray applied only.
 - 6 2. Temperature and weather conditions:
 - 7 a. Do not paint surfaces when surface temperature is below 50 DegF
8 unless product has been formulated specifically for low temperature
9 application and application is approved in writing by Engineer and paint
10 manufacturer's authorized representative.
 - 11 b. Avoid painting surfaces exposed to hot sun.
 - 12 c. Do not paint on damp surfaces.
 - 13 3. Immediately after surface has been inspected, apply structural steel and
14 miscellaneous steel and steel joist prime coat in the factory.
 - 15 a. Finish coats shall be applied in the factory.
 - 16 b. Prime coat referred to here is prime coat as indicated in this
17 Specification.
 - 18 1) Structural steel and miscellaneous steel and steel joist prime coating
19 applied in factory (shop) as part of Fabricator's standard rust
20 inhibiting and protection coating is not acceptable as replacement for
21 specified prime coating.
 - 22 4. Provide complete coverage to mil thickness specified.
 - 23 a. Thickness specified is dry mil thickness.
 - 24 b. All paint systems are "to cover." In situations of discrepancy between
25 manufacturer's square footage coverage rates and mil thickness, mil
26 thickness requirements govern.
 - 27 c. When color or undercoats show through, apply additional coats until
28 paint film is of uniform finish and color.
 - 29 5. If so directed by Engineer, do not apply consecutive coats until Engineer
30 has had an opportunity to observe and approve previous coats.
 - 31 6. Apply materials under adequate illumination.
 - 32 7. Evenly spread to provide full, smooth coverage.
 - 33 8. Work each application of material into corners, crevices, joints, and other
34 difficult to work areas.
 - 35 9. Avoid degradation and contamination of blasted surfaces and avoid
36 intercoat contamination.
 - 37 a. Clean contaminated surfaces before applying next coat.
 - 38 10. Smooth out runs or sags immediately, or remove and recoat entire surface.
 - 39 11. Allow preceding coats to dry before recoating.
 - 40 a. Recoat within time limits specified by coating manufacturer.
 - 41 b. If recoat time limits have expired re-prepare surface in accordance with
42 coating manufacturer's printed recommendations.
 - 43 12. Allow coated surfaces to cure prior to allowing traffic or other work to
44 proceed.
 - 45 13. Coat all aluminum in contact with dissimilar materials.
 - 46 14. When coating rough surfaces which cannot be backrolled sufficiently, hand
47 brush coating to work into all recesses.
 - 48 15. Backroll concrete and gypsum board and wood surfaces with a roller if paint
49 coatings are spray applied.

50 B. Prime Coat Application:

-
- 1 1. Prime all surfaces indicated to be painted.
- 2 a. Apply prime coat in accordance with coating manufacturer's written
- 3 instructions and as written in this Specification Section.
- 4 2. Ensure field-applied coatings are compatible with factory-applied coatings.
- 5 a. Ensure new coatings applied over existing coatings are compatible.
- 6 b. Employ services of coating manufacturer's qualified technical
- 7 representative.
- 8 1) Certify through material data sheets.
- 9 2) Perform test patch.
- 10 c. If field-applied coating is found to be not compatible, require the coating
- 11 manufacturer's technical representative to recommend, in writing,
- 12 product to be used as barrier coat, thickness to be applied, surface
- 13 preparation and method of application.
- 14 d. At Contractor's option, coatings may be removed, surface re-prepared,
- 15 and new coating applied using appropriate paint system listed in the
- 16 MATERIALS Article, Paint Systems paragraph of this Specification
- 17 Section.
- 18 1) All damage to surface as result of coating removal shall be repaired
- 19 to original condition or better by Contractor at no additional cost to
- 20 Owner.
- 21 3. Prime ferrous metals embedded in concrete to minimum of 1 IN below
- 22 exposed surfaces.
- 23 4. Back prime all wood scheduled to be painted, prior to installation.
- 24 5. After application of primer to gypsum board surfaces, inspect surface and
- 25 repair in accordance with the PREPARATION Article of this Specification
- 26 Section.
- 27 a. Re-prime repaired surfaces to uniform finish before application of finish
- 28 coat(s).
- 29 6. Apply zinc-rich primers while under continuous agitation.
- 30 7. Ensure abrasive blasting operation does not result in embedment of
- 31 abrasive particles in paint film.
- 32 8. Brush or spray bolts, welds, edges and difficult access areas with primer
- 33 prior to primer application over entire surface.
- 34 9. Touch up damaged primer coats prior to applying finish coats.
- 35 a. Restore primed surface equal to surface before damage.
- 36 10. All surfaces of steel lintels and steel components of concrete lintels used in
- 37 wall construction shall be completely painted with both prime and finish
- 38 coats prior to placing in wall.
- 39 C. Finish Coat Application:
- 40 1. Apply finish coats in accordance with coating manufacturer's written
- 41 instructions and in accordance with this Specification Section; manufacturer
- 42 instructions take precedent over these Specifications.
- 43 2. Touch up damaged finish coats using same application method and same
- 44 material specified for finish coat.
- 45 a. Prepare damaged area in accordance with the PREPARATION Article
- 46 of this Specification Section.

47 3.6 FIELD QUALITY CONTROL

- 48 A. Contractor to provide protection for surfaces painted with epoxy coatings to
- 49 prevent chalking.

-
- 1 1. Surfaces showing chalking will not be accepted regardless of condition of
2 paint film.
- 3 B. Maintain Daily Records:
- 4 1. Record the following information during application of each coat of paint
5 applied:
- 6 a. Date, starting time, end time, and all breaks taken by painters.
7 b. For exterior painting:
8 1) Sky condition.
9 2) Wind speed and direction.
10 c. Air temperature.
11 d. Relative humidity.
12 e. Moisture content and surface temperature of substrate prior to each
13 coat.
14 f. Provisions utilized to maintain work area within manufacturer's
15 recommended application parameters including temporary heating,
16 ventilation, cooling, dehumidification and provisions utilized to mitigate
17 wind blown dust and debris from contaminating the wet paint film.
18 g. Record environmental conditions, substrate moisture content and
19 surface temperature information not less than once every four (4) hours
20 during application.
21 1) Record hourly when temperatures are below 50 DegF or above 100
22 DegF.
- 23 2. Record the following information daily for the paint manufacturer's
24 recommended curing period:
- 25 a. Date and start time of cure period for each item or area.
26 b. For exterior painting:
27 1) Sky conditions.
28 2) Wind speed and direction.
29 c. Record environmental conditions not less than once every 12 hours.
30 1) Record once every four (4) hours when ambient temperature is
31 below 35 DegF.
32 d. Provisions utilized to protect each item or area and to maintain areas
33 within manufacturer's recommended curing parameters.
- 34 3. Format for daily record to be computer generated.
- 35 C. Measure wet coating with wet film thickness gages.
- 36 D. Measure coating dry film thickness in accordance with SSPC PA 2 using
37 Mikrotest gage calibrated against NBS "Certified Coating Thickness Calibration
38 Standards."
- 39 1. Engineer may measure coating thickness at any time during project to
40 assure conformance with these Specifications.
- 41 E. Measure surface temperature of items to be painted with surface temperature
42 gage specifically designed for such.
- 43 F. Measure substrate humidity with humidity gage specifically designed for such.
- 44 G. Provide wet paint signs.
- 45 3.7 CLEANING
- 46 A. Clean paint spattered surfaces.
- 47 1. Use care not to damage finished surfaces.

-
- 1 B. Upon completion of painting, replace hardware, accessories, plates, fixtures,
 - 2 and similar items.
 - 3 C. Remove surplus materials, scaffolding, and debris.

5 END OF SECTION
6

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

1.4 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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 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. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are 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, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Colors: As selected by Architect from manufacturer's full range or as indicated on the drawings.

2.3 PRIMERS/SEALERS

- A. Primer, Alkali Resistant, Water Based: MPI #3.
- B. Primer, Bonding, Water Based: MPI #17.

- C. Primer, Bonding, Solvent Based: MPI #69.

2.4 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.
- B. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
- C. Primer, Galvanized, Water Based: MPI #134.
- D. Primer, Galvanized: As recommended in writing by topcoat manufacturer.
- E. Primer, Quick Dry, for Aluminum: MPI #95.

2.5 WATER-BASED PAINTS

- A. Latex, Exterior Flat (Gloss Level 1): MPI #10.
- B. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.
- C. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.
- D. Light Industrial Coating, Exterior, Water Based (Gloss Level 3): MPI #161.
- E. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5): MPI #163.
- F. Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.

2.6 SOLVENT-BASED PAINTS

- A. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.
- B. Alkyd, Exterior, Semi-Gloss (Gloss Level 5): MPI #94.
- C. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.
- D. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5): MPI #81.
- E. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.

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 an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Portland Cement Plaster: 12 percent.
 - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. 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 or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
- B. 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.

3.4 CLEANING AND PROTECTION

- A. 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.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

- a. Prime Coat: Latex, exterior, matching topcoat.
- b. Prime Coat: Primer, alkali resistant, water based, MPI #3.
- c. Intermediate Coat: Latex, exterior, matching topcoat.
- d. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.
- e. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), MPI #15.
- f. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.
- g. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Paint System:

- a. Prime Coat: Floor paint, latex, low gloss (maximum Gloss Level 3), MPI #60.
- b. Intermediate Coat: Floor paint, latex, low gloss (maximum Gloss Level 3), MPI #60.
- c. Topcoat: Floor paint, latex, low gloss (maximum Gloss Level 3), MPI #60.

2. Alkyd Floor Enamel System:

- a. Prime Coat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
- b. Intermediate Coat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
- c. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
- d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

C. CMU Substrates:

1. Latex System:

- a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.

- d. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), MPI #15.
- e. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.
- f. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.

D. Steel Substrates:

1. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.
- b. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- d. Topcoat: Light industrial coating, exterior, water based (Gloss Level 3), MPI #161.
- e. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
- f. Topcoat: Light industrial coating, exterior, water based, gloss (Gloss Level 6), MPI #164.

2. Alkyd System:

- a. Prime Coat: Primer, alkyd, anticorrosive for metal, MPI #79.
- b. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- c. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- d. Topcoat: Alkyd, exterior, flat (Gloss Level 1), MPI #8.
- e. Topcoat: Alkyd, exterior, semi-gloss (Gloss Level 5), MPI #94.
- f. Topcoat: Alkyd, exterior, gloss (Gloss Level 6), MPI #9.

3. Quick-Drying Enamel System:

- a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5), MPI #81.
- d. Topcoat: Alkyd, quick dry, gloss (Gloss Level 7), MPI #96.

4. Aluminum Paint System:

- a. Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.
- b. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- c. Intermediate Coat: Aluminum paint, MPI #1.
- d. Topcoat: Aluminum paint, MPI #1.

E. Galvanized-Metal Substrates:

1. Latex System:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.

- b. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
- c. Intermediate Coat: Latex, exterior, matching topcoat.
- d. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.
- e. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), MPI #15.
- f. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.
- g. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.

2. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
- c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- d. Topcoat: Light industrial coating, exterior, water based (Gloss Level 3), MPI #161.
- e. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
- f. Topcoat: Light industrial coating, exterior, water based, gloss (Gloss Level 6), MPI #164.

3. Alkyd System:

- a. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
- b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- c. Topcoat: Alkyd, exterior, flat (Gloss Level 5), MPI #8.
- d. Topcoat: Alkyd, exterior, semi-gloss (Gloss Level 5), MPI #94.
- e. Topcoat: Alkyd, exterior, gloss (Gloss Level 5), MPI #9.

F. Aluminum Substrates:

1. Latex System:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.
- d. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), MPI #15.
- e. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.
- f. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.

2. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

- c. Topcoat: Light industrial coating, exterior, water based (Gloss Level 3), MPI #161.
- d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
- e. Topcoat: Light industrial coating, exterior, water based, gloss (Gloss Level 6), MPI #164.

3. Alkyd System:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- c. Topcoat: Alkyd, exterior, flat (Gloss Level 5), MPI #8.
- d. Topcoat: Alkyd, exterior, semi-gloss (Gloss Level 5), MPI #94.
- e. Topcoat: Alkyd, exterior, gloss (Gloss Level 5), MPI #9.

G. Stainless-Steel Substrates:

1. Latex System:

- a. Prime Coat: Primer, bonding, solvent based, MPI #69.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.
- d. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), MPI #15.
- e. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.
- f. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.

2. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, exterior, water based (Gloss Level 3), MPI #161.
- d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
- e. Topcoat: Light industrial coating, exterior, water based, gloss (Gloss Level 6), MPI #164.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).Steel.
 - 3. Galvanized metal.
 - 4. Aluminum (not anodized or otherwise coated).
 - 5. Gypsum board.

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.
- H. Master Painters Institute Painting Manual: MPI Painting Manual

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

- C. Samples: For each type of paint system and in each color and gloss of topcoat.
- D. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 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. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List." Where required to meet LEED credit requirements, use only MPI listed materials having an "L" rating designation.
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are 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, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. VOC Content: Products shall comply with Section 5.504.4.3 Paints and Coatings and Section 5.504.4.3.1 Aerosol paints and coatings of the 2010 California Green Building Standards Code.
- D. Colors: As selected by Architect from manufacturer's full range .

2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
- B. Primer, Alkali Resistant, Water Based: MPI #3.
- C. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.
- D. Primer, Latex, for Interior Wood: MPI #39.
- E. Primer Sealer, Alkyd, Interior: MPI #45.
- F. Primer, Bonding, Water Based: MPI #17.
- G. Primer, Bonding, Solvent Based: MPI #69.

2.5 METAL PRIMERS

- A. Primer, Rust-Inhibitive, Water Based: MPI #107.
- B. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
- C. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
- D. Primer, Galvanized, Water Based: MPI #134.
- E. Primer, Vinyl Wash: MPI #80.
- F. Primer, Quick Dry, for Aluminum: MPI #95.

2.6 WATER-BASED PAINTS

- A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
- B. Latex, Interior, (Gloss Level 2): MPI #44.

- C. Latex, Interior, (Gloss Level 3): MPI #52.
- D. Latex, Interior, (Gloss Level 4): MPI #43.
- E. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
- F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees): MPI #114.

2.7 SOLVENT-BASED PAINTS

- A. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.
- B. Alkyd, Interior, (Gloss Level 3): MPI #51.
- C. Alkyd, Interior, Semi-Gloss (Gloss Level 5): MPI #47.
- D. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.
- E. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5): MPI #81.
- F. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.

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 an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are 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 or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. 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.

3.4 CLEANING AND PROTECTION

- A. 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.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - e. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
 - f. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.

- g. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
- h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

2. Alkyd System:

- a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
- d. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
- e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
- f. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

B. CMU Substrates:

1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
- d. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
- e. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- f. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
- g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

2. Institutional Low-Odor/VOC Latex System:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1), MPI #143.
- d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #144.
- e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
- f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5), MPI #147.

3. Alkyd System:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
- b. Sealer Coat: Primer sealer, latex, interior, MPI #50.
- c. Intermediate Coat: Alkyd, interior, matching topcoat.
- d. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
- e. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
- f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
- g. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

C. Steel Substrates:

1. Latex over Alkyd Primer System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
- b. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- c. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79 or primer, alkyd, quick dry, for metal[, MPI #76].
- d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- e. Intermediate Coat: Latex, interior, matching topcoat.
- f. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
- g. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
- h. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- i. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
- j. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- k. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

2. Alkyd System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
- b. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- c. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79 or primer, alkyd, quick dry, for metal[, MPI #76].
- d. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- e. Intermediate Coat: Alkyd, interior, matching topcoat.
- f. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
- g. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
- h. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
- i. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

3. Quick-Drying Enamel System:

- a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5), MPI #81.
- d. Topcoat: Alkyd, quick dry, gloss (Gloss Level 7), MPI #96.

D. Galvanized-Metal Substrates:

1. Latex over Waterborne Primer System:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
- d. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
- e. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- f. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
- g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.

- h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

E. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System:

- a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
- d. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
- e. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- f. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
- g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

2. Alkyd System:

- a. Prime Coat: Primer, vinyl wash, MPI #80.
- b. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
- c. Intermediate Coat: Alkyd, interior, matching topcoat.
- d. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
- e. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
- f. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
- g. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

F. Gypsum Board Substrates:

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Prime Coat: Latex, interior, matching topcoat.
- c. Intermediate Coat: Latex, interior, matching topcoat.
- d. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
- e. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
- f. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- g. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
- h. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- i. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

2. Alkyd over Latex Primer System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
- d. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
- e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
- f. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

END OF SECTION 099123

SECTION 101402 - EXTERIOR SIGNAGE

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: Provide Project exterior signage including:

1. Sign Type 1: Entry Sign and Address
2. Sign Type 2: Overhead Directional
3. Sign Type 3: Information Regulatory Extra Large
4. Sign Type 4: Information Regulatory Large
5. Sign Type 5: Information Regulatory Medium
6. Sign Type 6: Information Regulatory Small
7. Sign Type 7: Accessible Parking Information
8. Sign Type 8: Traffic Stop Sign
9. Sign Type 9: Traffic One Way Sign
10. Sign Type 10: Bay Identification Sign
11. Sign Type 11: Bay Identification Suspended
12. Sign Type 12: Bay Warning Suspended

- B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete for concrete foundations, concrete fill in postholes, and setting anchor bolts in concrete foundations for signs.
2. Section 101404 "Interior Signage."

1.3 REFERENCES

- A. ADA/ADAAG/SAD – Standards for Accessible Design.
- B. American Society for Testing and Materials (ASTM):
 1. ASTM A 500/A 500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- C. American Welding Society (AWS):
 1. AWS D1.1: Structural Welding Code – Steel.
 2. AWS D1.2: Structural Welding Code – Aluminum.

- D. California Public Safety Codes – Title 19.
- E. California Title 24.
- F. Green Seal Standard GS 11 “Paints and Coatings.”
- G. International Building Code (IBC 2012), unless instructed to use or reference an earlier IBC dated code by the Project Architect.
- H. National Association of Architectural Metal Manufacturers (NAAMM) “Metal Finishes Manual.”
- I. National Electrical Code (NEC).
- J. National Fire Protection Association (NFPA).
- K. Office of Statewide Health Planning and Development (OSHPD) – Seismic and Life Safety Standards specific to California.
- L. South Coast Air Quality Management District (SCAQMD):
 - 1. Rule #1168 “Adhesive and Sealant Applications.
- M. Underwriter’s Laboratories (UL):
 - 1. UL Standard 48 – Signs.
 - 2. UL Standard 1570 – Fixtures.
- N. U.S. Green Building Council (USGBC) Leadership in Energy & Environmental Design (LEED).

1.4 COORDINATION

- A. Furnish templates, made from rigid material, and tolerance information, for placement of sign-anchorage devices embedded in permanent construction by other installers.
 - 1. Clearly mark with “Side A/Side B” reference and include directional marking denoting “North.”

1.5 ACTION SUBMITTALS

- A. General: Except as otherwise indicated, comply with requirements of Section 013300 “Submittal Procedures.”
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.

- C. Product Data: For each type of product.
1. Include fabrication details, material descriptions, overall dimensions, and dimensions of individual components.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 3. Include product data for paint, coatings, and other finish materials as required to show compliance with specified requirements.
- D. Material Data:
1. Submit material cost data for materials required to construct Work in place. Material cost shall reflect actual cost of material without Contractor mark-up.
 2. Provide manufacturer's information/data sheet or letter from manufacturer indicating location of manufacture, amount of recycled content (post consumer and industrial percentage in product,) and location of raw material harvest if within 500 miles of Project site.
- E. Shop Drawings: Provide one set of reproducible Shop Drawings in electronic Acrobat PDF format and as paper print set, drawn to scale, detailing sign fabrication and installation. Provide DVD with electronic copy of Shop Drawings.
1. Include fabrication and installation details relating to attachments to other work.
 2. Show sign mounting in plan and elevation; show supplementary supports and accessories to be provided by others clearly identified on shop drawings.
 3. Provide printed-paper copy layout of each sign type, not less than 1/2 size.
 4. Show locations of electrical service connections.
 5. Include schematic diagrams of electrical circuitry and components.
 6. Schedule and describe anchorage assemblies and their related components.
 7. Show location of inserts for anchors and supports, which are to be attached to structure or built into concrete or masonry, if any.
 8. Support and Backing in Walls: Sign Contractor with the assistance of the General Contractor, shall provide engineered Sign supports anchored to the building's structure where required and to meet applicable sign code requirements. Installations requiring Support or backing, within the building wall construction, shall be immediately relayed to the Architect of Record and Construction Manager's Representative for field coordination. Location plans and the dimension on the design drawings are to be utilized for typical placement of each sign type. Should any obstructions prohibit installing the signs in any given location, the General Contractor shall be notified immediately and the GC and architect shall provide an alternate location as required.
 9. Shop Drawings shall be new drawings prepared specifically for Project.
 - a. Re-submittal of issued Drawings with title block modifications are not acceptable.
- F. Engineering Drawings: Sealed and signed by Professional Engineer responsible for preparation of engineering analysis who thereby certifies preparing or supervising preparation of data to comply with specified requirements and recognized engineering principles and practices. Engineering Drawings include, but are not limited to:

1. Plans, elevations, sections, and details for fabrication and installation of sign structures and foundations indicating sizes, dimensions, and profiles; arrangement and provisions for jointing, supporting, anchoring, and fastening.
 2. Include details showing relationship with, attachment to, and reception of related Work.
 - a. Indicate details of adjoining Work, even though not included in Work of this Section, to ensure coordination of Work and Work of other Sections.
 - b. Reference Architect detail numbers where applicable.
- G. Engineering Analysis: Sealed and signed by Professional Engineer who thereby certifies preparing or supervising preparation of data to comply with specified requirements and recognized engineering principles and practices.
- H. Samples:
1. Paints and Coatings:
 - a. Color Samples: Submit 2 samples of each color, sheen, and texture of paint finish on minimum 4 by 6 inch aluminum sheets to simulate actual finish. Resubmit each sample as requested until required color, sheen, and texture are achieved.
 - b. Technical Specifications: Submit 2 copies of technical specifications of paint, coatings, and other finish materials.
 2. Lettering Patterns: Submit 2 full-size lettering patterns of sign messages, symbols, or other graphic elements related to sign fabrication.
 3. High Performance Graphic Film Copy: Submit 2 mounted, one-line samples of each size, color, typestyle, and font on pre-spaced tapes.
 4. Screen Processed Copy: Submit 2 blue-line prints of film positives.
 5. Hardware Samples: Submit 2 samples each of hardware such as hinges, locks, and fasteners that will be exposed to view.
- I. Mockup: Submit mockup to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.
1. Submit 1 mockup of each of following:
 - a. Sign Type 1: One Dimensional Letter
 - b. Sign Type 2: Section of Sign Panel
 - c. Sign Type 3: None Required
 - d. Sign Type 4: None Required
 - e. Sign Type 5: Section of Sign Showing Construction and Finishes
 - f. Sign Type 6: One Complete Sign with Copy Applied
 - g. Sign Type 7, 8, 9, 11, 12: None Required
 - h. Sign Type 10: One Complete Sign
 2. Subsequent fabrication shall conform to accepted mockups.
 3. Approval of mockups does not constitute approval of deviations from Contract Documents unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

J. Product Schedule: For exterior signage. Use same designations indicated on Drawings.

K. Delegated-Design Submittal: For exterior signage indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For exterior signage to include in emergency, operation, and maintenance manuals.

B. Record Submittals (As-Builts): Prepare and submit final record drawings, specifications, and current status documents for signs provided as Work of this Section.

1. Comply with requirements of Section 017839, except as otherwise indicated.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from same product run, that match products installed, that are packaged with protective covering for storage, and identified with labels describing contents.

1. Furnish 1 gallon of each finish paint color for touch-up purposes. Include information on each paint manufacture and order code numbers.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm regularly engaged in manufacture of exterior signage similar to products specified for this Project that have been in satisfactory service for minimum of 5 years.

1. Contractor shall demonstrate previous experience with Branding and Wayfinding signage programs.

2. Contractor shall provide examples of 3 signage programs successfully completed over past 5 years.

3. Contractor shall provide 3 letters of reference resulting from completion of signage projects over past 2 years.
 4. Contractor shall identify their proposed Project Management team, and provide resume for each team member that will be assigned to project, as well as an Organizational chart.
 5. Contractor shall develop a fabrication and installation project schedule.
 6. Contractor shall demonstrate capability for creating project database with customer/client accessibility, based upon receipt of NTP, outlining durations for submittals, submittal reviews, fabrication, installation, and completion.
- B. Installer Qualifications: Manufacturer or an entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel for both field and shop/production facility according to AWS D1.1/D1.1M, "Structural Welding Code – Steel ID1.2/D1.2M, "Structural Welding Code – Aluminum D1.3, "Structural Welding Code - Sheet Steel D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- D. Professional Engineer Qualifications: A professional structural engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- E. Ready-Mix-Concrete Manufacturer Qualifications: Firm experienced in manufacturing ready-mixed concrete complying with ASTM C94/C94M requirements for production facilities and equipment.
- F. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Comply with sign fabricator's / manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
 - B. Submit detailed description of crating methods and materials used for shipment of large scale, fabricated signs or letters to Project team for review and approval prior to actual crating and shipping. Secure finished signage components within crate and protect from shipping or weather related damage.
 - C. Deliver to jobsite in sign fabricators / manufacturer's original unopened and undamaged packaging with identification labels intact.
 - D. Store in lockable, clean, dry area protected from weather, temperature, and other harmful conditions in accordance with sign fabricator's / manufacturer's written instructions.
 - E. Handle products in accordance with manufacturer's written instructions.

1.11 FIELD CONDITIONS

A. Field Measurements:

1. Inspect existing conditions and verify dimensions related to fabrication and installation of exterior signage prior to production.
2. Verify locations of anchorage devices and electrical services provided for signage installation embedded in permanent construction by other installers by field measurements before fabrication.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in function, materials, or workmanship within specified warranty period.

1. Failures include, but are not limited to following, as applicable to each sign type:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - d. Mounting failure.
 - e. Electrical failure.
 - f. Structural failure.
2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into Work include, but are not limited to:

1. 3M
2. Akzo Nobel
3. APCO Graphic, Inc
4. Arlon Graphics, LLC
5. ASI Sign Systems, Inc
6. BK Lighting
7. GE Lighting Solutions
8. Hydrel Lighting
9. KIM Lighting
10. Matthews Paint Co
11. Philips / ColorKinetics
12. PPG
13. Sign Comp
14. Sign Systems
15. Zumar Industries, Inc

2.2 FABRICATORS

A. Fabricators: Subject to compliance with requirements, available fabricators approved for fabricating signage components and assemblies specified in this Section include, but are not limited to:

1. AD/S Design & Signs.
2. CNP /California Neon Products.
3. CREO Industrial Arts.
4. Fabrication Arts.
5. Jon Richards Company.
6. National Sign and Marketing Corporation.
7. Neiman & Company.
8. Sign Designers.
9. Sign Industries.
10. TFN Architectural Signage
11. T Graphics, Inc.
12. Tube Art Group.
13. Weidner Architectural Signage.
14. Windsor Displays.

2.3 SYSTEM DESCRIPTION

A. Frame and Enclosure:

1. Design, fabricate and install structural and non-structural support framing in accordance with requirements of authorities having jurisdiction.
2. Design to provide for movement of components without damage, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
3. Design system to accommodate construction tolerances, deflection of structural members, and clearances of intended openings of associated structures.
4. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with requirements of authorities having jurisdiction for seismic zone #4.
5. Design exterior signage to withstand positive and negative wind loads calculated in accordance with requirements of authorities having jurisdiction.

2.4 PERFORMANCE REQUIREMENTS

- A. Design Rights: Sign Fabricator is hereby granted limited right to designs as indicated on Design Drawings and specified in this Section for sole purpose of completing contractual obligations to fabricate and install Project signage. Sign Fabricator may not manufacture, reproduce, or exhibit designs or modify designs for any other purpose without prior written consent.
- B. Substitutions: No substitutions to fabrication process or material selections allowed unless approved by Architect/Designer in writing prior to fabrication.

C. Sign Fabricator's Responsibilities:

1. Provide labor, materials, and products required to fabricate and install exterior signage and graphic items detailed, noted, or specified in Contract Documents.
2. Obtain and pay for required permits and taxes.
3. Provide engineering design as required for approvals and permits.
4. Provide typographic copy layouts and other finished artwork, unless otherwise specified.
5. Provide for Union Labor (where required) for installation of finished signage.
6. Provide sufficient support and coordination throughout following phases:
 - a. Submittal of shop drawings.
 - b. On-site field surveys.
 - c. Signage Fabrication.
 - d. In-shop design milestone reviews.
 - e. RFI process.
 - f. Coordination of shipping/delivery of finished signage to job site.
 - g. Final Installation.
 - h. Participation in final punch-list walk.
 - i. Correction of any identified deficiencies noted by project Design team and/or Client.

D. Delegated Design:

1. Engage a qualified Professional Engineer as defined in this Section to design sign structure and anchorage.
 - a. Provide complete engineering drawings and calculations sealed and signed by responsible engineer.
 - b. Provide engineering design as required for approvals and permits

E. Accessibility Standard: Comply with applicable provisions in U.S. Architectural & Transportation Barriers Compliance Board's ADA/ADAAG Accessibility Guidelines for Buildings and Facilities, SAD (Standards for Accessible Design), and ICC A117.1 for signs.

2.5 MATERIALS

A. Acrylic Polyurethane Paint:

1. Manufacturers: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. AKZO Nobel.
 - b. Matthews Paint Co.
 - c. PPG.
2. General: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
3. Paint systems/products must be either Ultra Low VOC or Low VOC compliant.

- B. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
1. Manufacturers: Subject to compliance with requirements, manufacture's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Evonite Cyro, LLC: Acrylite.
 - b. Rohm and Haas: Plexiglas.
- C. Adhesives:
1. Manufacturers: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Dow Corning.
 - b. General Electric
 - c. Lord Adhesive.
- D. Anti-Graffiti Aerosol Spray Coating.
1. Basis of Design Product: Subject to compliance with requirements, provide Low VOC Satin Clear, Low VOC Gloss Clear, Low VOC Braco Clear (for decorative metals), or Low VOC Super Satin Clear/Anti Graffiti as manufactured by Mathews Paint Co. or product by following meeting or exceeding performance requirements of Basis of Design product:
 - a. Spraylat.
 - b. Or approved equal.
- E. Anti-Graffiti Protective Film:
1. Basis of Design Product: Subject to compliance with requirements, provide Scotchcal Matte Overlaminat 3642 GPS as manufactured by 3M or product by one of following meeting or exceeding performance requirements of Basis of Design product:
 - a. Arlon Graphics, LLC.
 - b. Or approved equal.
- F. Aluminum Sheet and Plate: ASTM B 209, alloy and temper indicated.
1. Provide alloy 5005-h32 for anodized finishes and alloy 3003-h14, mill finish, for painted finishes.
 2. Where alloy and temper are not indicated, provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- G. Aluminum Extrusions: ASTM B 221, alloy and temper indicated.
1. Provide alloy 6063 T-6 for anodized finishes and alloy 6061 T-6, mill finish, for painted finishes.

2. Where alloy and temper are not indicated, provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 3. Anodizing and Plating: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Danco.
 - b. LNL Anodizing.
 - c. Highland Plating.
- H. Screen Printing Ink: Subject to compliance with requirements, provide product by one of following manufacturers or equal product meeting or exceeding performance requirements of a named manufacturer.
1. Warnow; Decal Du_Well Enamel.
 2. Nazdar Inks.
 3. Or approved equal.
- I. Very High Bond Foam and TransferTape:
1. Basis of Design Product: Subject to compliance with requirements, provide VHB Acrylic Foam Tape, and VHB Isotac Tape as manufactured by 3M.

2.6 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with following:
1. Use concealed fasteners and anchors unless indicated on accepted Shop Drawings to be exposed.
 2. Furnish stainless steel devices unless otherwise indicated.
 3. Furnish stainless steel masonry inserts for embedment in concrete or masonry work.
 4. Furnish stainless steel j-bolts for embedment in concrete or masonry work.
 5. Furnish stainless steel All Thread to be secured with epoxy adhesive into concrete or masonry work.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C1107M. Provide grout specifically recommended by manufacturer for exterior applications.
- D. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:
1. Compressive Strength: As required by design conditions but not less than 3000 psi at 28 days.

- E. High Strength Concrete Mix /"SAKRETE": Prepare bag mix per manufacturers instructions, in accordance with ACI 302, ACI 308 and ASTM C 387, as follows:
- F.
 - 1. Compressive Strength: As required by design conditions but not less than 4000 psi at 28 days.
- G. Silicone Adhesive:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Dow.
 - b. General Electric.
 - c. C.R. Lawrence.
- H. Structural Adhesive:
 - 1. Basis of Design Product: Provide Versilok two-component epoxy-modified acrylic adhesive, with beads, as manufactured by Lord Corporation recommended by adhesive manufacturer for each application or, subject to compliance with requirements, comparable product by one of following, or equal:
 - a. Akzo Nobel; Liquid Nails Construction Adhesive.
 - b. Henkel Loctite Corporation; Loctite Construction Adhesive.
 - c. Or approved equal.

2.7 CONCRETE

- A. General: Match Architect's control samples for colors, tint additives, finish textures and chamfers.
- B. Formwork: Design, construct, erect, brace, and maintain formwork in accordance with ACI 301.
- C. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- D. Mixing:
 - 1. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - a. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 - 2. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

- a. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - b. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional cu. yd.
 - c. Provide batch ticket for each batch discharged and used in Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.
- E. Concrete Placement: Comply with ACI 301 for placing concrete.
 - F. Finishing: Comply with ACI 302.1R for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
 - G. Protection: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
 - H. Repairs: Remove and replace concrete that does not comply with requirements in this Section.

2.8 FABRICATION

- A. General: Manufacturer shall provide labor, materials, tools, fixtures, jigs, equipment, and facilities necessary for production of Work required by Contract Documents.
 - 1. Preassemble signs in shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
 - 4. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
 - 5. Internally brace signs for stability and for securing fasteners.
 - 6. Form panels to required size and shape as indicated on Drawings. Comply with requirements for design, dimensions, finish, color, and details of construction.
 - 7. Obtain identification labels which shall conform to Underwriters Laboratories requirements.
 - 8. Locate markings, labels, and manufacturer names and other identifications so as to be concealed from public view and as acceptable to Owner's Representative.
 - 9. Provide wet stamped engineering calculations
 - 10. On new sign products of duplicate design and fabrication, vendor shall assume interchangeability of components, regardless of manufacturing origins.

11. For sign cabinets mounted to walls and other vertical surfaces, or to roofs and other horizontal surfaces and to concrete footings, use stainless steel anchoring hardware.
12. Provide stainless steel aircraft cable and zinc plated mounting hardware and fittings for hanging or suspending signage or graphics components.

B. Aluminum Cabinets:

1. Provide cabinets of seamless welded aluminum construction with brake formed returns where applicable and joints welded, ground and finished smooth.
 - a. Provide internal structural framing of welded aluminum construction.
 - b. Use sourced and approved aluminum extrusions for cabinet bodies, retainers, posts, and frames, where applicable.
 - c. For internally illuminated sign cabinets, paint interior surfaces white to optimize reflection.
 - d. Flat or Formed Acrylic or Polycarbonate Sheet Surfaces: Allow for expansion and contraction to prevent blowout.
 - e. Except as otherwise indicated, fasteners shall be stainless steel and concealed; when exposed, fasteners shall be countersunk and finished to match adjacent surface.
 - f. Electrolysis: Prevent corrosive action due to electrolysis by separating ferrous and non-ferrous metals with neoprene or vinyl spacers, or by using stainless steel fasteners.

C. Very High Bond Tape (VHB):

1. Provide type of VHB recommended in writing by tape manufacturer for each tape application.
2. Apply tape in accordance with tape manufacturer's written instructions for each tape application.
 - a. Pre-treat surfaces prior to application of tape, removing oil and foreign matter and lightly sand bonding surfaces prior to tape application.
 - b. Prior to removal of carrier tape, burnish tape to first applied surface to activate adhesive properties.
 - c. Re-burnish bond areas and clamp elements together for time specified by tape manufacturer.

2.9 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work / "Fabrication": Noticeable variations within same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

- C. Appearance of Finished Work / "Paint": Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved samples and are assembled or installed to minimize contrast.

2.10 PAINT FINISH

- A. Performance Requirements: Five years acceptable performance is required of approved paint systems. Acceptable performance is defined as follows:
 - 1. Will not crack, check, or peel (lose adhesion) except when cracking or crazing is a result of metal fracture.
 - 2. Will not chalk in excess when measured in accordance with the standard procedures as defined by the "Standard Methods of Evaluating Degree of Chalking of Exterior paints", ASTM D4214-89.
 - 3. Will not fade or change in color when exposed painted surfaces, which have been cleaned of external deposits and chalk, are measured by a spectrophotometer or color meter. It is understood that fading or color change may not be uniform if the surfaces are not equally exposed to the sun and elements.
 - a. Process requirements - All surfaces shall be degreased, cleaned, and rinsed well. Drying the substrate may be necessary to prevent white rust. Remove mill scale by sandblasting if necessary.
 - b. Scuff metal surfaces and make ready for self-etching primer. Apply wash / filler primer in multiple passes, yielding a minimum of .5 mil dry film thickness.
 - c. Apply finish paint, following manufactures recommendations for mixing and application.
 - d. Apply sprayed on, Low VOC protective clear coat /anti graffiti finish, following manufacturers recommendations for mixing and application. Final applied clear coat finish shall be Satin Clear.
- B. Perform crosshatch adhesion test on painted parts as prescribed by ASTM D3359-93 "Standard Test Methods for Measuring Adhesion by Tape Test".

2.11 COPY AND GRAPHICS APPLICATION

- A. General Requirements: Provide Adobe Type I Postscript Font available from Adobe Systems for copy applications except as otherwise noted on Drawings. Typestyle indicated on Drawings is for information only. For production, provide software able to reproduce project graphics exactly.
 - 1. Ensure that size and placement of copy comply with dimensions for letter height, line spacing, and placement as either noted on Drawings, in digital files, or final approved lettering patterns.
 - 2. Ensure that baselines of copy are straight and parallel with top or bottom of sign structure unless otherwise noted.
 - 3. Ensure that edges of letter forms and numerals are true and smooth with straight and curved sections representing specified Project typestyle exactly.

4. Letterforms, numerals and graphics shall be free of imperfections and distortions of straight lines or curves. Rounded letter forms shall extend slightly below normal baseline per respective typestyle characteristics.
- B. Screen Printed Copy: Provide photo-mechanically produced screens for copy and characters from computer generated files. Print copy using fine mesh screens and screening inks.
1. Pre-treat surfaces by applying one protective coat of clear acrylic polyurethane.
 2. Ensure that surface of letters are uniform in color, finish, and free of pinholes and imperfections.
 3. Match sign message and background colors to approved color samples in every respect for consistency in chroma, value, and coverage.
 4. Provide sign colors that maintain proper opacity or translucency and are free of blistering, bleeding, or fading. Color registration shall be crisp, sharp, and free of imperfection.
 5. Ink colors to match colors as specified on drawings.
- C. Masked and Painted copy and graphics Applications: Provide machine cut copy and character painting masks from computer-generated files.
1. Pre-treat surfaces for painting in accordance with paint manufactures specifications and recommendations.
 2. Surfaces shall be smooth and free of dust, grease, wax, or other foreign matter.
 3. Paint types for application conditions to be in accordance with paint manufacturer's specification and recommendations. Paint colors to match colors specified on Drawings.
- D. Direct Digital Print Copy and Graphics Applications: Provide direct digital printing on specified substrate from computer generated files using flat bed four color ink jet printer.
1. Prepare surface for printing in accordance with printer manufactures specification and recommendations.
 2. Surfaces shall be smooth and free of dust, grease, wax, or other foreign matter prior to application.
 3. Ink types for application conditions to be in accordance with printer manufacture specifications and recommendations. Ink colors to match colors specified on Drawings.
- E. Direct Digital Printing
1. Material Substrates, including but not limited to:
 - a. Aluminum sheet.
 - b. Adhesive backed vinyl film.
 - c. Painted acrylic sheet.
 - d. Unpainted acrylic sheet.
 - e. Polycarbonate.
 2. Protective Finish Coatings

- a. Applied clear vinyl film.
 - b. Sprayed on protective finish.
 - c. Rolled on protective finish.
 - 3. Surfaces shall be smooth and free of dust, grease, wax or other foreign matter prior to application.
 - 4. Production Process: Provide digitally printed control samples of project color palette for fabricators to match with samples from their digital printing output, fabricator sample subject to approval.
- F. Anti-Graffiti Coating applied to Finished Signs:
- 1. Apply anti-graffiti aerosol spray coating in accordance with coating manufacturer's written recommendations for each application.
 - 2. Apply anti-graffiti protective film in accordance with film manufacturer's written recommendations for each application.
- G. Anti-graffiti Coatings for sign Faces: Apply 3M Scotchcal Matte Overlamine 3642 GPS anti-graffiti film to sign faces. Apply after copy has been applied per manufacturer's instructions.
- H. Frisket masked and Painted:
- 1. Mask and paint process onto material substrates, including by not limited to:
 - a. Painted aluminum.
 - b. Painted acrylic or polycarbonate.
 - c. Facility concrete wall or surfaces, or CMU walls.
 - 2. Preparation: Comply with paint manufacturer's written recommendation for each substrate to be painted.
 - 3. Protective Finish Coating
 - a. Sprayed on clear coat; Select one of following Low VOC finish sheens as determined by Project Design Team on Project to Project basis:
 - 1) Matte.
 - 2) Satin.
 - 3) Gloss.

2.12 QUALITY CONTROL

- A. Provide work-in-progress sign elements for review. Scheduled viewings at Shop or Factory may be initiated as deemed necessary to ensure continued quality control during fabrication.
 - 1. Correct unsatisfactory items as directed.

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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs.
- C. Verify that concrete sign footings are sacked, finished and chamfered, and without cracks or broken edges.
- D. Verify that pre-installed anchors, if any, are correctly sized and located to accommodate signs.
- E. Verify that dedicated electrical circuit is located to accommodate illuminated signs.
- F. Locate pre-installed external sign lighting, if applicable, and verify clearance for sign installation.
- G. Review documents and confirm conditions and dimensions indicated and identify number of units and locations of Project signage.
 - 1. Sign locations indicated on Drawings are for reference only. Exact locations shall be field verified with Owner's Representative prior to installation.
 - 2. Identify sign locations on site by numbered stake that includes sign type item number.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install exterior signage using installation methods indicated and in accordance with manufacturer's written instructions.
 - 1. Signs shall be produced by authorized manufacturers and installed by Union sign companies where required. For State of California, work shall be completed by C-45 licensed installers.
 - 2. Signs shall be installed only after securing proper permits and complying with local ordinances. Should a variance be required, installation shall be placed on hold until such time as proper authorization is granted.
 - 3. Installation work shall be performed in accordance with OSHA standards (Occupational Safety and Health Administration). Equipment shall be operated in a safe manner, with safe clearances between work area and any nearby utility lines.
 - 4. Coordinate underground excavation with local utility board prior to commencing earth removal.
 - 5. Disposal of material shall be performed in accordance with prevailing environmental laws and governmental agencies.

6. Open excavations shall not be abandoned for any reason. If overnight completion is required, excavation shall be surrounded with reflective barricades clearly indicating construction zone.
7. Installation contractor shall not erect damaged signs or components. Shipping damage shall be reported to manufacturer and repair or replacement made prior to installation.
8. Installation work shall be performed in accordance with OSHPD standards, and certain facilities may require coordination and approval of OSHPD inspection.
9. Install signage level and plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
10. Install signs so they do not protrude or obstruct, in accordance with applicable accessibility standards.
11. Prior to installation, verify that sign components are clean and free of materials or debris that could impair installation.
12. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with heavy coat of bituminous paint.
13. Connect electrical signs to stubbed power source. Test lighting components after dark to ensure functionality.
14. Remove temporary protective coverings and strippable films as signs are installed.
15. Restore adjacent building surfaces damaged during exterior signage installation to original condition.
 - a. Preserve sod and topsoil and replace after backfilling is completed
 - 1) Replace damaged sod with sod of quality equal to that removed.
 - b. Where surface is disturbed in newly seeded area, restore surface to be reseeded with same quantity and formula seed as that used in original seeding.

3.3 ADJUSTING AND CLEANING

- A. Adjust hardware and electrical equipment for proper operation.
- B. Clean glass, frames, and other exterior signage surfaces in accordance with manufacturer's written instructions.
- C. Remove damaged or deformed exterior signage and signage that does not comply with specified requirements. Replace with exterior signage complying with requirements.
- D. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- E. Maintain exterior signage in clean condition during remainder of construction and protect from damage until acceptance by Owner.
- F. Remove packing materials, cartons, and any trash from the Site at the end of each days work.

1. To maximum extent possible, recycle materials in accordance with requirements of USGBC and requirements and initiatives of agencies having jurisdiction.

3.4 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of signage Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper signage operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of two hours or less.
 3. "Acts of God", "Acts of nature", or similar term shall be applicable to wind related effects only when recorded wind speeds at nearest official weather recording station exceed Basic Wind Speed for that location as defined by prevailing building code.

3.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Project Design Team's List of Incomplete Items (Punch List): Prepare and submit list of items requiring completion or correction, indicating value of each item on list and reasons for Work being incomplete.

END OF SECTION 101402

SECTION 101404 - INTERIOR SIGNAGE

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: Provide Project interior signage including:
 - 1. Sign Type 20: Welcome Signage Modular/Changeable
 - 2. Sign Type 25: Wayfinding Directional Medium
 - 3. Sign Type 30: Dimensional Copy
 - 4. Sign Type 40: Room Identification Tactile & Braille Plaque
 - 5. Sign Type 41: Room Identification Tactile & Braille Plaque Changeable Insert
 - 6. Sign Type 43: Room Identification Tactile & Braille Plaque In-Use Window
 - 7. Sign Type 45: Restroom Identification ADA
 - 8. Sign Type 46: Restroom Identification Title 24
 - 9. Sign Type 48: Room Identification Exterior Grade Tactile & Braille Plaque
 - 10. Sign Type 50: Egress Directional ADA Code Plaque Small
 - 11. Sign Type 52: Emergency Evacuation
 - 12. Sign Type 53: Equipment Identification Flag
 - 13. Sign Type 70: Information/Regulatory Plaque Small
 - 14. Sign Type 71: Information/Regulatory Plaque Large
- B. Related Requirements:
 - 1. Section 101402 "Exterior Signage."

1.3 REFERENCES

- A. ADA/ADAAG/SAD – Standards for Accessible Design.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 500/A 500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- C. American Welding Society (AWS):
 - 1. AWS D1.1: Structural Welding Code - Steel.
 - 2. AWS D1.2: Structural Welding Code – Aluminum.
- D. California Public Safety Codes -Title 19.
- E. California Title 24.
- F. Green Seal Standard GS 11 "Paints and Coatings".
- G. International Building Code (IBC 2012), unless instructed to use or reference an earlier IBC dated code by the Project Architect.

- H. National Association of Architectural Metal Manufacturers (NAAMM) “Metal Finishes Manual”.
- I. National Fire Protection association (NFPA).
- J. Office of Statewide Health Planning and Development (OSHPD) –Seismic and Life Safety Standards specific to California.
- K. South Coast Air Quality Management District (SCAQMD):
 - 1. Rule #1168 “Adhesive and Sealant Applications.
- L. Underwriters Laboratories (UL):
 - 1. UL Standards 48 - Signs.
 - 2. UL Standard 1570 - Fixtures.
- M. U.S. Green Building Council (USGBC) Leadership in Energy & Environmental Design (LEED).

1.4 COORDINATION

- A. Furnish templates made from rigid material and provide tolerance information for placement of sign-anchorage devices to be embedded in permanent construction by other installers.
 - 1. Clearly mark each template with a “Side A / Side B” reference, and include a directional marking to denote “North.”

1.5 ACTION SUBMITTALS

- A. General: Except as otherwise indicated, comply with requirements of Section 013300 “Submittal Procedures”.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: For adhesives, sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
 - 3. Product Data for Credit IEQ 4.2: For paints and coatings used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Product Data: For each type of product.
 - 1. Include fabrication details, material descriptions, dimensions overall and dimensions of individual components.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include data for paint, coatings, and other finish materials as required to show compliance with specified requirements.
- D. Material Data:

1. Submit material cost data for materials required to construct Work in place. Material cost shall reflect actual cost of material without added Contractor mark-up.
 2. Provide manufacturer's information/data sheet or letter from manufacturer indicating location of manufacture, amount of recycled content (post consumer and industrial percentage in product), and location of raw material harvest if within 500 miles of Project site.
 3. If requested by Owner, submit manufacturer's Material Safety Data Sheet (MSDS) directly to Owner.
- E. Shop Drawings: Provide one set of reproducible Shop Drawings in electronic Acrobat PDF format and as a paper print set, drawn to scale, detailing sign fabrication and installation. Provide DVD with electronic copy of Shop Drawings.
1. Include fabrication and installation details relating to attachments to other work.
 2. Show sign mounting in plan and elevation; show supplementary supports and all accessories to be provided by others, clearly identified on the shop drawings.
 3. Provide printed-paper copy layout of each sign type, not less than 1/2 size.
 4. Show locations of electrical service connections.
 5. Include schematic diagrams of electrical circuitry and components.
 6. Schedule and describe sign anchorage assemblies and their related components.
 7. Show location of inserts for anchors and supports, which are to be attached to structure or built into concrete or masonry, if any.
 8. Support and Backing in Walls (new construction): Sign Contractor with the assistance of the General Contractor shall provide engineered sign supports anchored to the building's structure where required and to meet applicable sign code requirements. Installations requiring support or backing within the building wall construction shall be immediately relayed to the Architect of Record and Construction Manager's Representative for field coordination. Location plans and the dimensions on the design drawings to be utilized for placement of each sign type. Should any obstructions prohibit installing the signage in any given location, the General Contractor (GC) shall be notified immediately and the GC and Architect shall provide alternate locations as required.
 9. Support and Backing in Walls (existing construction): Sign Contractor with the assistance of the General Contractor shall provide engineered sign supports anchored to the building's existing structure or framing (i.e. metal or wood studs) as required, to meet applicable sign code requirements. For conditions where metal stud framing exists, install finished signage using sheet metal fasteners / screws set directly into studs. However, for existing field conditions where wood or metal wall studs are inaccessible, but where the finished walls consist of gyp board anchored to internal framing, the finished signage shall be installed using Easy Anchor drywall anchors (or equal), with sheet metal screws, set into the gyp board over framed walls. Installations requiring additional support or backing within the building wall construction shall be immediately relayed to the Architect of Record and Construction Manager's Representative for field coordination. Location plans and the dimensions on the design drawings to be utilized for placement of each sign type. Should any obstructions prohibit installing the signage in any given location, the General Contractor (GC) shall be notified immediately and the GC and Architect shall provide alternate locations as required
 10. Shop Drawings shall be new drawings prepared specifically for the Project.

- a. Re-submittal of issued Drawings with title block modifications is not acceptable.
11. Shop drawings may be submitted electronically, saved as a pdf file, for review and comment by the design team.
- F. Engineering Drawings and Analysis: Sealed and signed by Professional Structural Engineer, responsible for preparation of engineering analysis who thereby certifies preparing or supervising preparation of data to comply with specified requirements and recognized engineering principles and practices. Engineering Drawings include, but are not limited to:
 1. Plans, elevations, sections, and details for fabrication and installation of sign structures indicating sizes, dimensions profiles and arrangement and provisions for jointing, supporting, anchoring, and fastening.
 2. Include details showing relationship with, attachment to, and reception of related Work (i.e. "Retrofit to Existing Structure").
 - a. Indicate details of adjoining Work, even though not included in Work of this Section, to ensure coordination of Work and Work of other Sections.
 - b. Reference Architect detail numbers where applicable.
- G. Samples:
 1. Paints and Coatings:
 - a. Color Samples: Submit 2 samples of each color, sheen, and texture of paint finish on minimum 4 by 6 inch aluminum sheet to simulate the actual finish. Resubmit each sample as requested until required color, sheen, and texture are achieved.
 - b. Technical Specifications: Submit 2 copies of technical specifications of paint, coatings, and other finish materials.
 2. Lettering Patterns: Submit 2 full-size lettering patterns of sign messages, symbols, or other graphic elements related to sign fabrication.
 3. High Performance Graphic Film Copy: Submit 2 mounted, one-line samples of each size, color, typestyle, and font on pre-spaced tapes.
 4. Screen Processed Copy: Submit 2 prints of film positives.
 5. Hardware Samples: Submit 2 samples each of hardware such as hinges, locks, and fasteners that will be exposed to view.
- H. Sign Prototype: Submit prototype to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.
- I. Samples:
 1. Submit 1 prototype of each of the following:
 - a. Sign Type 20, 25, 52, 53, 70, 71: One Complete Sign Including Copy Application
 - b. Sign Type 30: One Finished Letter
 - c. Sign Type 43, 46, 50: None Required
 - d. Sign Type 40, 41, 45, 48: One tactile, dimensional room ID sign with Grade 2 Braille.

2. Subsequent fabrication shall conform to accepted prototypes.
 3. Approval of prototypes does not constitute approval of deviations from Contract Documents unless the Architect / Designer specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved prototypes may become part of completed Work if undisturbed at time of Substantial Completion.
- J. Graphics Schedule: For interior signage, reference the same sign item numbers as indicated on Drawings.
- K. Delegated-Design Submittal: For Interior signage indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional structural engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: To include in emergency, operations, and maintenance manuals.
- B. Record Submittals (As-Builts): Prepare and submit final record drawings, specifications, and current status documents, saved in digital/pdf format for signs provided as Work of this Section.

1. Comply with requirements of Section 017839, except as otherwise indicated.

1.8 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. Provide extra stock of following:
 - a. Furnish 1 quart of each finish paint color for touch-up purposes. Include information on each paint manufacturer and order code numbers.

1.9 QUALITY ASSURANCE

- A. Sign Contractor Qualifications: Company regularly engaged in the manufacture of Interior signage similar to product specified for this Project, and which have been in satisfactory service for a minimum of 5 years.
 1. Contractor shall demonstrate previous experience with Branding and Wayfinding signage programs.
 2. Contractor shall provide examples of three signage projects / programs successfully completed over the past 5 years.
 3. Contractor shall develop a fabrication and installation project schedule, and demonstrate the capability for creating a project database with customer / client accessibility, based upon receipt of Notice to Proceed, and outlining the

durations for submittals, submittal reviews, fabrication, installation and Project completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Sign Contractor's ordering instructions and lead-time requirements to avoid construction delays.
- B. Submit detailed description of crating method and materials used for shipment of large scale, fabricated signs or letters to Project team for review and approval prior to actual crating and shipping. Secure finished signage components within crate and protect from shipping or weather related damage.
- C. Deliver to jobsite in Sign Contractor's original unopened and undamaged packaging with identification labels intact.
- D. Store in lockable, clean, dry area protected from weather, temperature, and other harmful conditions in accordance with Sign Contractor's written instructions.
- E. Handle products in accordance with Sign Contractor's written instructions.

1.11 FIELD CONDITIONS

- A. Field Measurements:
 - 1. Inspect existing conditions and verify dimensions related to fabrication and installation of Interior signage prior to production.
 - 2. Verify locations of any anchorage devices and /or electrical service provisions specific to the signage installation, and any embedments made within permanent construction and executed by others. Recheck site /in-field conditions prior to the final graphics installations.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in function, materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to following, as applicable to each sign type:
 - a. Deterioration of finishes beyond normal wear.
 - b. Deterioration of embedded graphic image.
 - c. Separation or de-lamination of sheet materials and components.
 - d. Mounting failure.
 - e. Structural failure.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into Work include, but are not limited to:

1. 3M
2. AKZO Nobel
3. Arlon Graphics, LLC
4. ASI Sign Systems, Inc
5. Matthews Paint Co
6. Philips /ColorKinetics
7. PPG
8. Sign Comp
9. Sign Systems

2.2 FABRICATORS

- A. Fabricators: Subject to compliance with requirements, available fabricators approved for fabricating signage components and assemblies specified in this Section include, but are not limited to:

1. AD/S Design & Signs
2. CNP / California Neon Products
3. CREO Industrial Arts
4. Fabrication Arts
5. Icon Identity Solutions
6. Jon Richards Company
7. Sign Designers
8. T Graphics
9. Windsor Displays

2.3 PERFORMANCE REQUIREMENTS

- A. Design Rights: Sign Contractor is hereby granted limited right to designs as indicated on Design Drawings and specified in this Section for sole purpose of completing contractual obligations to fabricate and install Project signage. Sign Contractor may not manufacture, reproduce, or exhibit designs or modify designs for any other purpose without prior written consent.
- B. Substitutions: No substitutions to fabrication process or material selections allowed unless approved by Architect / Designer in writing prior to fabrication.
- C. Sign Contractor's Responsibilities:
1. Provide labor, materials, and products required to fabricate and install Interior signage and graphic items detailed, noted, or specified in Contract Documents.
 2. Identify Signage permit costs, obtain the required permit/s, and cover all costs associated to said permits, including plan checks submittals, processing fees and all applicable taxes.
 3. Provide engineering design as required for approvals and permits.
 4. Provide typographic copy layouts, and other finished artwork, unless otherwise specified.
 5. Provide for Union Labor (where required) for installation of finished signage.
 6. Provide sufficient support and coordination throughout the following phases:
 - a. Submittal of shop drawings.
 - b. On-site field surveys.
 - c. Sign prototypes.

- d. Sign fabrication.
 - e. In-shop design milestone reviews.
 - f. RFI process.
 - g. Coordination of shipping/delivery of finished signage to job site.
 - h. Final installation.
 - i. Participation in final punch-list walk.
 - j. Correction of any identified deficiencies noted by project Design team and/or Client.
- D. Delegated Design:
- 1. Engage a qualified professional structural engineer as defined in this Section to design sign structure and anchorage.
 - a. Provide complete engineering drawings and calculations sealed and signed by responsible engineer.
 - b. Provide engineering design as required for approvals and permits.
- E. Accessibility Standard: Comply with applicable provisions in U.S. Architectural & Transportation Barriers Compliance Board's ADA/ADAAG Accessibility Guidelines for Buildings and Facilities, SAD (Standards for Accessible Design), and ICC A117.1 for signs.
- F. Electrical Components: Listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

2.4 MATERIALS

- A. Acrylic Polyurethane Paint:
- 1. Manufacturers: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. AKZO Nobel.
 - b. Matthews Paint Co.
 - c. PPG.
 - 2. General: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
 - 3. Paint systems / products must be either Ultra Low VOC or Low VOC compliant.
- B. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- 1. Manufacturers: Subject to compliance with requirements, manufacture's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Evonite Cyro, LLC: Acrylite.
 - b. Rohm and Haas: Plexiglas.
- C. Adhesives:
- 1. Manufacturers: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Dow Corning.

- b. General Electric.
 - c. Lord Adhesive.
- D. Anti-Graffiti Aerosol Spray Coating:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide one of the following finishes: Low VOC Satin Clear, Low VOC Gloss Clear, Low VOC Braco Clear (for decorative metals), or Low VOC Super Satin Clear/anti graffiti as manufactured by Matthews Paint Co. <Specify anti-graffiti coating> or product by the following meeting or exceeding performance requirements of Basis of Design product:
 - a. Spraylat.
- E. Anti-Graffiti Protective Film:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Scotchcal Matte Overlamine 3642 GPS as manufactured by 3M or product by the following, meeting or exceeding performance requirements of Basis of Design product:
 - a. Arlon Graphics, LLC.
- F. Aluminum Sheet and Plate: ASTM B 209, alloy and temper indicated.
 - 1. Provide alloy 5052-h32 for anodized finishes and alloy 3003-h14, mill finish, for painted finishes.
 - 2. Where alloy and temper are not indicated, provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- G. Aluminum Extrusions: ASTM B 221, alloy and temper indicated.
 - 1. Provide alloy 6063 T-6 for anodized finishes and alloy 6061 T-6, mill finish, for painted finishes.
 - 2. Where alloy and temper are not indicated, provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - 3. Anodizing and Plating: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work to include, but are not limited to:
 - a. Danco
 - b. LNL Anodizing
 - c. Highland Plating
- H. Interior Digital Color Prints:
 - 1. Manufacturers: Subject to compliance with requirements (Piezo ink jet printed and / or a Mimaki UV Digital Printer, with an acceptable overlamine or applied second surface, and a Design life of 3-5 years), manufacturer's offering products that may be incorporated in the Work include, but are not limited to:
 - a. Color Edge.
 - b. Lithographix.
 - c. Rembrandt.

- d. Supercolor Digital.
- I. Screen Printing Ink: Subject to compliance with requirements, provide product by one of following manufacturers or equal product, meeting or exceeding performance requirements of a named manufacturer:
 - 1. Warnow; Decal Du-Well Enamel.
 - 2. Nazdar Inks.
- J. Very High Bond Foam and Transfer Tape:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide VHB Acrylic Foam Tape, and VHB Isotac Tape as manufactured by 3M.

2.5 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, non-corrosive and compatible with each material joined, and complying with the following:
- B. Silicone Adhesive:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturer's offering products that may be incorporated in the Work to include, but are not limited to:
 - a. Dow.
 - b. General Electric.
 - c. C.R. Lawrence.
- C. Structural Adhesive:
 - 1. Basis of Design Product: Provide Versilok two-component epoxy-modified acrylic adhesive, with beads, as manufactured by Lord Corporation recommended by adhesive manufacturer for each application or, subject to compliance with requirements, comparable product by one of following:
 - a. Akzo Nobel; Liquid Nails Construction Adhesive.
 - b. Henkel Loctite Corporation; Loctite Construction Adhesive.

2.6 FABRICATION

- A. General: Manufacturer shall provide labor, materials, tools, fixtures, jigs, equipment and facilities necessary for production of Work required by Contract Documents.
 - 1. Preassemble signs in shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
 - 2. Mill joints to tight, hairline fit.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
 - 4. Conceal fasteners and anchors unless indicated as exposed; locate exposed fasteners where they will be inconspicuous.

5. Internally brace signs for stability and for securing fasteners.
 6. Form panels to required size and shape as indicated on Drawings. Comply with requirements for design, dimensions, finish, color, and details of construction.
 7. Obtain identification labels, which shall conform to Underwriters Laboratories requirements.
 8. Locate markings, labels, and manufacturer names and other identifications so as to be concealed from public view and as acceptable to Owner's Representative.
 9. Provide wet stamped engineering calculations.
 10. On new sign products of duplicate design and fabrication, vendor shall assume interchangeability of components, regardless of manufacturing origins.
 11. For sign cabinets mounted to walls and other vertical surfaces, or to other horizontal surfaces, use zinc or steel anchoring hardware.
 12. Provide stainless steel aircraft cable and zinc plated mounting hardware and fittings for hanging or suspending signage or graphics components.
- B. Very High Bond Tape (VHB):
1. Provide type of VHB recommended in writing by tape manufacturer for each tape application.
 2. Apply tape in accordance with tape manufacturers written instructions for each tape application.
 - a. Pretreat surfaces prior to application of tape, removing oil and foreign matter and lightly sand bonding surfaces prior to tape application.
 - b. Prior to removal of carrier tape, burnish tape to first applied surface to activate adhesive properties.
 - c. Reburnish bond areas and clamp elements together for time specified by tape manufacturer.
- C. Acrylic Panels: Finish exposed edges of panels smooth with polished or painted finish as noted on Drawings. All edges to be eased and exposed lamination seams shall not be permitted.
- D. ADA / ADAAG / SAD Code Compliant Signs:
1. Option /Tactile Sign: Sign face shall have an applied sheet of surface painted raised copy and Grade 2 translation Braille, and be bonded to the sign substrate. Photopolymer material to be specified as Exterior grade product.
 2. Option /Tactile Sign: Sign face shall have applied Laser cut surface painted raised copy and transparent Grade 2 translation (Raster bead) Braille, bonded into holes engraved into sign face after painting.
 3. Edges shall be flush, eased and finished.
 4. Spray paint panel face, background and edges.
- E. California / Title 24 Compliant Restroom Signs:
1. Provide painted acrylic equilateral triangle panel with eased edges for attachment to Men's Restroom door.
 2. Provide painted acrylic circular disk panel with eased edges for attachment to Women's Restroom door.
 3. Provide painted acrylic equilateral triangle panel with eased edges and direct digital print male and female symbols bonded over painted acrylic circular disk panel with eased edges for attachment to Unisex Restroom door.
- F. Regulatory Signs:

1. Provide acrylic panel with eased edges and 1/8" radiused corners and with direct digital print copy and or symbol.
2. Production Options for Copy and Symbols on Signage: Screen print or Direct Digital print.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping
- B. Appearance of Finished Work / "Fabrication": Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.
- C. Appearance of Finished Work / "Paint": Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved samples and are assembled or installed to minimize contrast.

2.8 PAINT FINISH

- A. Performance Requirements: Five years acceptable performance is required of approved paints systems. Acceptable performance is defined as follows:
 1. Will not crack, check, or peel (lose adhesion) except when cracking or crazing is a result of metal fracture.
 2. Will not fade or change in color when exposed painted surfaces (which have been cleaned of external deposits and chalk), are measured by a spectrophotometer or color meter. It is understood that fading or color change may not be uniform if the surfaces are not equally exposed.
 - a. Process requirements - All surfaces shall be degreased, cleaned, and rinsed well. Drying the substrate may be necessary to prevent white rust. Remove any mill scale by sandblasting if necessary.
 - b. Scuff metal surfaces and make ready for self-etching primer. Apply wash/filled primer, in multiple passes, yielding a minimum of .5 mil dry film thickness.
 - c. Apply Low VOC paint finish , following the manufactures recommendations for mixing and application.
 - d. Follow with a sprayed on, Ultra Low VOC protective clear coat/anti graffiti finish, adhering to the manufacturers recommendations for mixing and application. Final applied clear coat finish shall be Satin Clear.
- B. Perform crosshatch adhesion test on painted parts as prescribed by ASTM D3359-93 "Standard Test Methods for Measuring Adhesion by Tape Test".

2.9 COPY AND GRAPHICS APPLICATION

- A. General Requirements: Provide Adobe Type I Postscript Font available from Adobe Systems for copy applications except as otherwise noted on Drawings. Typestyle indicated on Drawings is for information only. For production, provide software able to reproduce project graphics exactly.

1. Ensure that size and placement of copy comply with dimensions for letter height, line spacing, and placement as either noted on Drawings, in digital files, or final approved lettering patterns.
 2. Ensure that baselines of copy are straight and parallel with top or bottom of sign structure unless otherwise noted.
 3. Ensure that edges of letterforms and numerals are true and smooth with straight and curved sections representing the specified Project typestyle exactly.
 4. Letterforms, numerals and graphics shall be free of imperfections and distortions of straight lines or curves. Rounded letter forms shall extend slightly below normal baseline per respective typestyle characteristics.
- B. Screen Printed Copy: Provide photo-mechanically produced screens for copy and characters from computer generated files. Print copy using fine mesh screens and screening inks.
1. Pre-treat surfaces by applying one protective coat of clear acrylic polyurethane.
 2. Ensure that surface of letters are uniform in color, finish, and free of pinholes and imperfections.
 3. Match sign message and background colors to approved color samples in every respect for consistency in chroma, value, and coverage.
 4. Provide sign colors that maintain proper opacity or translucency and are free of blistering, bleeding, or fading. Color registration shall be crisp, sharp, and free of imperfection.
 5. Ink colors to match colors as specified on drawings.
- C. Masked and Painted Copy and Graphics Applications: Provide machine cut copy and character painting masks from computer-generated files.
1. Pre-treat surfaces for painting in accordance with paint manufactures specifications and recommendations.
 2. Surfaces shall be perfectly smooth and free of dust, grease, wax, or other foreign matter.
 3. Paint types for application conditions to be in accordance with paint manufacturer's specification and recommendations. Paint colors to match colors as specified on Drawings.
- D. Direct Digital Print Copy and graphics Applications: Provide direct digital printing onto specified substrate from computer generated files using flat bed four color ink jet printer. Prepare surface for printing in accordance with printer manufactures specification and recommendations.
1. Surfaces shall be smooth and free of dust, grease, wax, or other foreign matter prior to application.
 2. Ink types for application conditions to be in accordance with printer manufacture specifications and recommendations. Ink colors to match colors specified on Drawings.
 3. Minimum DPI / resolution requirements - 600 DPI
- E. Direct Digital Printing:
1. Material Substrate not limited to:
 - a. Aluminum sheet.
 - b. Adhesive backed vinyl film.
 - c. Painted acrylic sheet.

- d. Unpainted acrylic sheet.
 - e. Painted polycarbonate sheet.
 - f. Unpainted polycarbonate sheet.
2. Protective Finish Coatings not limited to:
- a. Applied clear vinyl film.
 - b. Sprayed on protective finish.
 - c. Rolled on protective finish.
3. Surfaces shall be smooth and free of dust, grease, wax or other foreign matter prior to application.
4. Production Process: Provide digitally printed control samples of project color palette for fabricators to match with samples from their digital printing output, fabricator sample subject to approval.
- F. Anti-graffiti Coatings for sign Faces: Apply 3M Scotchcal Matte Overlamine 3642 GPS anti-graffiti film to all sign faces. Apply after copy has been applied per manufacturer's instructions.
- G. Anti-Graffiti Coating applied to Finished Signs:
- 1. Apply anti-graffiti aerosol spray coating in accordance with coating manufacturer's written recommendations for each application.
- H. Frisket masked and Painted:
- 1. Mask and paint process onto material substrates, not limited to:
 - a. Painted aluminum.
 - b. Painted acrylic or polycarbonate.
 - c. Onto facility concrete or CMU wall surfaces.
 - 2. Preparation: Comply with paint manufacturer's written recommendation for each substrate to be painted.
 - 3. Protective Finish Coating:
 - a. Sprayed on clear coat; Select one of the following Low VOC finish sheens as determined by the Project Design Team, and on a per Project basis:
 - 1) Matte.
 - 2) Satin.
 - 3) Gloss.

2.10 QUALITY CONTROL

- A. Provide work-in-progress sign elements for review. Scheduled viewings at Shop or Factory may be initiated as deemed necessary to ensure continued quality control during fabrication.
 - 1. Correct unsatisfactory items as directed.

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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs.
- C. Verify that pre-installed anchors, if any, are correctly sized and located to accommodate signs.
- D. Verify existence of dedicated electrical circuit and location for support of illuminated signs.
- E. Locate pre-installed external sign lighting if applicable, and verify clearance for sign installation.
- F. Review documents and confirm conditions and dimensions indicated and identify number of units and locations of Project signage.
 - 1. Sign locations indicated on Drawings are for reference only. Exact locations shall be field verified with Owner's Representative prior to installation.
 - 2. Identify sign locations / placement on site using blue 3M painters tape strips applied to the actual signage locations, and which incorporates the sign type item number.
- G. Proceed with installation only after any unsatisfactory field conditions have been corrected.

3.2 INSTALLATION

- A. General: Install Interior signage using installation methods indicated and in accordance with the manufacturer's written instructions.
 - 1. Signs shall be produced by authorized manufacturers and installed by Union sign companies where required. For the State of California, work shall be completed by C-45 licensed installers.
 - 2. Signs shall be installed only after securing proper permits and complying with local ordinances. Should a variance be required, installation shall be placed on hold until such time as proper authorization is granted.
 - 3. Installation work shall be performed in accordance with OSHA standards (Occupational Safety and Health Administration). Equipment shall be operated in a safe manner, with safe clearances between the work area and any surrounding objects or structures.
 - 4. Disposal of material shall be performed in accordance with prevailing environmental laws and governmental agencies.
 - 5. Installation contractor shall not erect damaged signs or components. Shipping damage shall be reported to manufacturer and repair or replacement made prior to installation.
 - 6. Installation work shall also be performed to be in compliance with OSHPD standards, and certain facilities may require additional coordination and approval, including an OSHPD inspection.
 - 7. Install signage level and plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 8. Install signs so they do not protrude or obstruct, in accordance with applicable accessibility standards.
 - 9. Prior to installation, verify that sign components are clean and free of materials or debris that could impair installation.

10. Connect electrical signs to stubbed power source. Test lighting components after dark to ensure functionality.
11. Remove temporary protective coverings and strippable films as signs are installed.
12. Installers to be knowledgeable regarding current Signage Code Requirements.

3.3 ADJUSTING AND CLEANING

- A. Adjust hardware and electrical equipment for proper operation.
- B. Clean glass, frames, and other signage surfaces in accordance with manufacturer's written instructions.
- C. Remove damaged or deformed signage, or any signage that does not comply with specified requirements. Replace with signage complying with requirements.
- D. Replace signs having damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- E. Maintain Interior signage in clean condition during remainder of construction and protect from damage until acceptance by Owner.
- F. Remove packing materials, cartons, and any trash from Site at end of each workday.
 1. To maximum extent possible, recycle materials in accordance with requirements of USGBC and the requirements and initiatives of agencies having jurisdiction.

3.4 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of signage Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper signage operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of two hours or less.

3.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Project Design Team's List of Incomplete Items (Punch List): Prepare and submit a list of items to be completed and corrected, indicating the value of each item on the list and reasons why the Work is incomplete.

END OF SECTION 101404

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: For adhesives, sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.
- D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75] or less.
 2. Smoke-Developed Index: 450 or less.
- B. Recycled Content of Solid-Plastic Components: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. All American Metal Corp.
 2. American Sanitary Partition Corporation.
 3. Ampco, Inc.
 4. Bradley Corporation; Mills Partitions.
 5. General Partitions Mfg. Corp.
 6. Global Steel Products Corp.
 7. Knickerbocker Partition Corporation.
 8. Marlite.
 9. Metpar Corp.
- B. Toilet-Enclosure Style: Floor anchored.
- C. Urinal-Screen Style: Wall hung
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum[or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 3. Color and Pattern: Two colors and patterns in each room as selected by Architect from manufacturer's full range
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
1. Polymer Color and Pattern: Contrasting with pilaster, as selected by Architect from manufacturer's full range >.
- F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters matching that on the pilaster.

- G. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.
 - 2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
 - a. Polymer Color and Pattern: Contrasting with panel, as selected by Architect from manufacturer's full range.
- H. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
 - 1. Material: Stainless steel
 - 2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- B. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.
 - 1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

- D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.19

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall guards.
 - 2. Corner guards.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - 2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
- C. Shop Drawings: For each impact-resistant wall protection unit. Include sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

1.4 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- D. Preinstallation Conference: Conduct conference at Project site

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout.
 - 1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) notch when tested according to ASTM D 256, Test Method A.
 - 2. Chemical and Stain Resistance: Tested according to ASTM D 543
 - 3. Self-extinguishing when tested according to ASTM D 635.
 - 4. Flame-Spread Index: 25 or less.
 - 5. Smoke-Developed Index: 450 or less.
- B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.

- C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.
- D. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- E. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of **70** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 WALL GUARDS

- A. Crash Rail Heavy-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system; designed to withstand impacts.
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. [American Floor Products Co., Inc.](#)
 - b. [Arden Architectural Specialties, Inc.](#)
 - c. [Balco, Inc.](#)
 - d. [Construction Specialties, Inc.](#)
 - e. [IPC Door and Wall Protection Systems; Division of InPro Corporation.](#)
 - f. [Korogard Wall Protection Systems; a division of RJF International Corporation.](#)
 - g. [Musson Rubber Company.](#)
 - h. [Pawling Corporation.](#)
 - i. [Tepromark International, Inc.](#)
 - j. [WallGuard.com.](#)
 - 2. Cover: Extruded rigid plastic, minimum 0.100-inch (2.5-mm) wall thickness; in dimensions and profiles indicated on Drawings.
 - a. Surface: Uniform
 - b. Color and Texture: As selected by Architect from manufacturer's full range
 - 3. Continuous Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
 - 4. Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
 - 5. Bumper: Continuous rubber or vinyl bumper cushion(s).

6. End Caps and Corners: Prefabricated, injection-molded plastic; matching color > cover; field adjustable for close alignment with snap-on cover.
7. Accessories: Concealed splices and mounting hardware.
8. Mounting: Surface mounted directly to wall

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm).
 - c. Adjust end and top caps as required to ensure tight seams.
- B. Immediately after completion of installation, clean plastic covers and accessories using a standard household cleaning agent.
- C. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102600 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. **A & J Washroom Accessories, Inc.**
2. **American Specialties, Inc.**
3. **Bobrick Washroom Equipment, Inc.**
4. **Bradley Corporation.**
5. **GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.**
6. **Tubular Specialties Manufacturing, Inc.**

B. **Basis of Design Product Schedule :**

1. Liquid-Soap Dispenser (wall mounted): Bobrick B-855 or B112, stainless steel - satin finish
2. Toilet Seat Cover Dispenser (recessed unless noted otherwise): Bobrick B-301, stainless steel - satin finish
3. Combination Towel (Folded) Dispenser/Waste Receptacle (semi-recessed unless noted otherwise): Bobrick B-3942, stainless steel - satin finish.
4. Sanitary-Napkin Dispenser (recessed, unless noted otherwise): Bobrick B-3706 25, stainless steel – satin finish
5. Mirror: Bobrick (24x36 with frame, unless noted otherwise)
6. Toilet Tissue Dispenser (surface mounted): Bobrick B-2888
7. Stainless Steel Grab Bar: Bobrick B-6806 x 42 stainless steel - satin finish.
8. Sanitary-Napkin Disposal (surface mounted): Bobrick B-254, stainless steel - satin finish.
9. Stainless Steel Grab Bar: Bobrick B-6806 x 36, stainless steel - satin finish.

2.2 UNDERLAVATORY GUARDS

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. **Plumberex Specialty Products, Inc.**
2. **Truebro by IPS Corporation.**

2.3 FABRICATION

A. **Keys:** Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION 102800

**SECTION 10 29 00
BIRD CONTROL DEVICE**

PART 1 – GENERAL

1.01 SYSTEM DESCRIPTION

- A. Bird Control: Physical control system constructed of stainless steel strip and wire to prevent pest birds and climbing animals from landing, roosting, nesting or climbing on architectural surfaces.
- B. Mounting Hardware: Mounting clips and fasteners designed to securely fasten bird control to architectural surfaces. Hardware is made of stainless steel or non-corrosive materials.

1.02 QUALITY ASSURANCE

- A. Installer obtain, review, and understand manufacturer's planning guides, estimating worksheets and installation instructions.
- B. Installer be completely familiar with proper installation procedures for product specified.
- C. Installer be completely familiar with specified mounting hardware and mounting hardware installation procedures.

1.03 STORAGE & HANDLING

- A. Provide storage to keep shipping boxes dry, clean and undamaged. Do not stack or place other packaging on shipping boxes.
- B. Keep bird control strips and mounting hardware in original packaging until needed for installation.

1.04 SUBMITTALS

- A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.
- B. Leadership in Energy and Environmental Design (LEED®) Documentation: Submit the following in accordance with Section 01 81 30 – Sustainability Requirements:
 - 1. Completed LEED Materials Submittal Form.
 - 2. Product Data for MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content; include statement indicating costs for each product having recycled content.

PART 2 – PRODUCTS

2.01 BIRD BARRIER STRIPS

- A. Manufacturers:
 - 1. Bird-B-Gone, Inc. (www.birdbgone.com).

- 2. Nixalite of America, Inc (www.nixalite.com).
 - 3. Bird-X (www.bird-x.com).
 - 4. Or approved equal.
- B. Barriers: Stainless steel wire and strip barriers.
- 1. Wires: High grade stainless steel, 0.041 IN DIA, full-hard spring temper, 250,000 LBS/IN tensile strength.
 - 2. Base Strip: High grade stainless steel, 0.25 IN wide x 0.02 IN thick, full anneal for flexibility, easy strip cutting and surface shape memory.
- C. Strip Lengths: 48 IN strip lengths.
- D. 5-1/2 IN high, 3 IN wide, NO LESS THAN 120 wires per foot, 180-degree wire coverage. Wall mount model for vertical surfaces only. Use above surfaces less than 2 IN depth.
- E. Finish: Natural stainless steel finish.

2.02 STRIP MOUNTING HARDWARE

- A. To be made of stainless steel materials. Hardware to allow for strip removal and reinstallation without causing damage to installation surface, the strips or mounting system.
- B. Mounting hardware that best suits the installation surface. All hardware listed is made of stainless steel.

INSTALLATION SURFACE	MOUNTING HARDWARE UNIT
Sheet metal, plastic, PVC	Mounting clip, sheet metal screw, washer
Steel, cast iron, brass, bronze	Mounting clip, drive screw, washer
Pipes, cables, conduit, grates	Wire tie, wire tying tool, adhesive

- C. Optional Fastening:
 - 1. Custom Forms: Use custom made stainless steel form, bracket or strap to fasten bird control strips to difficult surface with limited or zero surface penetration requirements.
 - 2. Glue Clips & Adhesive: If surface conditions do not allow for the use of the mounting hardware, use the glue clip and adhesive installation method.

2.03 MAINTENANCE MATERIALS

- A. Extra Materials:
 - 1. Provide 10 percent additional extra material to Project Representative.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Visually inspect installation surfaces. Make sure surfaces are clean, dry and free from debris or other conditions that could impede workflow of this section.
- B. Notify Project Representative of detrimental conditions. Do not proceed until these conditions have been corrected.

3.02 PREPARATION

- A. Field Measurements: Verify dimensions of each installation surface.
- B. Make sure all installation surface finishing requirements have been accomplished before installing bird control. DO NOT apply any surface coating or treatment (paint, sealer, etc.) over the installed bird control or mounting hardware.
- C. Remove or relocate all plants or foliage that overhangs the installation surfaces.

3.03 SURFACE CLEANING

- A. Surfaces to be clean, dry and free of obstructions before bird control is installed.
- B. IF BIRD WASTE IS PRESENT: Treat, neutralize and safely remove all bird waste from installation surfaces. Installer must follow all City, State and Federal regulations regarding the proper removal and disposal of bird droppings.
- C. Use surface cleaning products to neutralize any bird droppings, nests and related waste materials that may be present. Allow all surfaces to air dry completely, and then reapply to sanitize and deodorize the surface before proceeding. Strictly follow treatment instructions provided with surface cleaning products.
- D. Use anti-bacterial personal protection products to help prevent disease transmittal when working around surfaces contaminated with bird droppings.

3.04 INSTALLATION

- A. Strip:
 - 1. Install strip in strict accordance with manufacturer's strip spacing and installation guidelines. Protect all surfaces.
 - 2. Protect the entire surface, not just the outside edges. NO GAPS allowed in the bird barrier strip coverage. Cut strips where necessary to fit the surface properly.
 - 3. Wires of to extend over outside edge of surface by at least 1/4 IN. Base strips to extend over any open end of surface by at least 1/2 IN.

4. Fasten to the surface with the mounting hardware recommended by the manufacturer. Follow hardware spacing guidelines and installation procedures supplied by manufacturer.
5. Bird control is designed for vertical surfaces only. Do not install horizontally (down flat). Use over surfaces less than 2 IN in depth or as recommended by manufacturer.
6. Protect the entire surface, not just the outside edge of a surface. Follow all the spacing guidelines provided by manufacturer.

3.05 ADJUSTMENTS / CLEANING

- A. Remove debris and waste materials from project site.
- B. Inspect finished installation. Make any adjustments to conform to spacing and installation guidelines.
- C. Visually inspect finished installation. Make any adjustments needed to conform to manufacturer's spacing and installation guidelines.

END OF SECTION 102900

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated.
 - c. Badger Fire Protection.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - h. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - i. Larsens Manufacturing Company.
 - j. Moon American.
 - k. Nystrom Building Products.
 - l. Pem All Fire Extinguisher Corp.
 - m. Potter Roemer LLC.
 - n. Pyro-Chem; Tyco Safety Products.
 - o. Strike First Corporation of America.
 - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
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. Amerex Corporation.
 - b. Ansul Incorporated.
 - c. Fire End & Croker Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - f. Larsens Manufacturing Company.
 - g. Nystrom Building Products.
 - h. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 124816 - ENTRANCE FLOOR GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes recessed floor grilles and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Information:
 - 1. MR 4– Recycled Content: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content; include statement indicating costs for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.1: Low-Emitting Materials –Adhesives and Sealants
- C. Shop Drawings:
 - 1. Items penetrating floor grilles and frames, including door control devices.
 - 2. Divisions between grille sections.
 - 3. Perimeter floor moldings.
- D. Samples: For foot grilles and frame members.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arden Architectural Specialties, Inc.
 - 2. Balco, Inc.
 - 3. Cactus Mat Mfg. Co.

4. Crowder, K. N. Manufacturing, Inc.
5. C/S Group.
6. J. L. Industries, Inc.
7. Kadee Industries, Inc.
8. Mats Inc.
9. Pawling Corporation; Architectural Products Division.
10. Reese Enterprises, Inc.

2.2 ENTRANCE FLOOR GRILLES, GENERAL

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 FLOOR GRILLES

- A. Aluminum Floor Grilles: Provide manufacturer's standard floor grilles with extruded members, top-surfaced tread rails, and as follows:
 1. Aluminum Color: As selected by Architect from full range of industry colors and color densities.
 2. Tread Rail Spacing: 1-1/2 inches (38 mm) o.c. with 1/8- to 3/16-inch- (3.2- to 4.8-mm-)wide openings between treads.
 3. Top Surface: Serrated aluminum.
 - a. Top Surface Color: As selected by Architect from manufacturer's full range of industry colors.
 4. Grille Size: As indicated.
- B. Lockdown: Manufacturer's standard

2.4 FRAMES

- A. Provide manufacturer's standard frames of size and style for grille type.

2.5 SUPPORT SYSTEM

- A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.
- B. Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

2.6 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- C. Aluminum Sheet: ASTM B 209 (ASTM B 209M).
- D. Extruded Aluminum: ASTM B 221 (ASTM B 221M).
- E. Stainless-Steel Angles: ASTM A 276 or ASTM A 479/A 479M, corrosion resistant, Type 304.

2.7 FABRICATION

- A. Shop fabricate floor grilles to greatest extent possible in sizes as indicated.
- B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install recessed floor grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of floor grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set floor-grille tops at height for most effective cleaning action. Coordinate top of floor-grille surfaces with doors that swing across grilles to provide clearance under door.

3.2 PROTECTION

- A. After completing frame installations, provide temporary filler of plywood or fiberboard in floor-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124816

SECTION 129313 BICYCLE RACKS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Bicycle Parking Racks - Exterior
 - 2. Bicycle Parking Rack - Interior

1.2 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has completed installation of bicycle lockers similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing site furnishing products similar to those required for this project and with a record of successful in-service performance.
- C. **Source Limitations:** Obtain each color, finish, and type of bicycle locker from a single source with resources to provide components of consistent quality in appearance and physical properties.
- D. **Product Options:** Drawings indicate size, shape and dimensional requirements of bicycle lockers and are based on the specific system indicated.

1.3 REFERENCES

- A. **Steel Sheet:**
 - 1. ASTM A653 Standard Specification for Steel Sheet, G90 Bonderized
- B. **Steel Pipe:**
 - 1. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM A312 Standard Specification for Seamless and Welded Stainless Steel Pipes
 - 3. ASME SA312 Standard Specification for Seamless and Welded Stainless Steel Pipes

1.4 SUBMITTALS

- A. **Product Data:** Include physical characteristics such as shape, dimensions, bicycle parking capacity and finish.
- B. **Shop Drawings:** Show assembly and installation details.
- C. **Samples for Verification:** Showing;
 - 1. The color of the powder coat finish. Prepare 2 inch by 3.5-inch (50.8 mm by 87.5mm) powder coat samples (or larger) from the same material to be used to finish the product,
 - 2. The actual galvanized finish. Prepare a sample piece of sufficient size to judge its quality.

- D. Maintenance Data: Include recommended methods for repairing damage to the powder coat finish.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store bicycle lockers in original undamaged packaging until ready for installation.
- B. Handle powder coated products with sufficient care to prevent any scratches or damage to the finish.
- C. Store bicycle parking racks in original undamaged packages and containers until ready for installation.

1.6 WARRANTY

- A. Bicycle racks and lockers are to carry a one year manufacturer's limited warranty against defects in materials and workmanship. The one year warranty period begins the date the product is shipped from the manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide bicycle parking racks manufactured by Madrax, Division of Trilary, Inc. or approved equal.
- B. Provide interior vertical bike hanger manufactured by Bike Solutions of Vermont Manufacturing Services, Inc. or approved equal

2.2 MATERIALS

- A. Powder Coating: Triglycidyl isocyanurate (TGIC) powder, a polyester coating.
 - 1. Color as selected by architect from manufacturer's full range of standard colors.

2.3 BICYCLE RACKS

- A. The bicycle parking rack shall be the Original Cycloops Series #2170 bicycle parking rack as manufactured by Columbia Cascade or approved equal. Rack shall be constructed of ASTM A53, 2" Schedule 40 steel pipe (2-3/8" O.D. x 0.154" thick wall (60.3mm x 3.9mm)) or better. Rack shall be a minimum of 42" (1066.8mm) high to provide proper clearance for parked bicycles.
- B. Capacity - 4 bicycles min.

2.4 BICYCLE HANGERS

- A. The bicycle hanger shall be the Mini Mum bicycle vertical bicycle hanger as manufactured by Bike Solutions, Division of Vermont Manufacturing Services, Inc. or approved equal. Rack shall be

constructed of ASTM A53, 2" Schedule 40 steel pipe (2-3/8" O.D. x 0.154" thick wall (60.3mm x 3.9mm)) or better. Rack shall be a minimum of 42" (1066.8mm) high to provide proper clearance for parked bicycles.

- B. Height: 8" (20.3 cm). Width: 3" (7.6 cm). Depth: 5" (12.7 cm). Weight: 1.4 lbs (0.6 kg) without cable; 2.2 lbs (1 kg) with cable.
- C. Construction: Steel plate and 3/8" (9.5 mm) diameter steel rod.
- D. Finish: Powder coat Black standard.
- E. Mount (exterior or interior): To vertical surfaces only; Recommend two 3/8" x 2" bolts with anchors in masonry or concrete; 3/8" x 2" lag screws for wood; Mounting surface must be capable of supporting weight of several bikes.
- F. Spacing: Hang all bikes by front wheel: Mount hanger brackets 5'-8" high at 24" intervals. Hang bikes by alternate front and rear wheels: Mount hanger brackets 5'-8" high at 16" intervals. Bike project +/- 40" from surface of wall. Recommend 5 ft. wide corridor
- G. (3 ft. minimum) for access to bikes. Allow adequate space at room corners for access to bikes (considering 40" bike projection).
- H. Capacity: Min. One bicycle.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Handle and install bicycle lockers and racks in accordance with manufacturer's recommendations and installation instructions.
- B. Set bicycle racks secured to construction, level and true to line, in correct relationship to adjacent materials.

**SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING 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, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 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.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

**SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Link Seal.
 - 2. Metraflex Company (The).
 - 3. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
2. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
3. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

**SECTION 220518
ESCUTCHEONS FOR PLUMBING PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

**SECTION 220519
METERS AND GAGES FOR PLUMBING PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Test plugs.
7. Test-plug kits.
8. Sight flow indicators.

B. Related Sections:

1. Section 211313 "Wet-Pipe Sprinkler Systems"
2. Section 221116 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Palmer Wahl Instrumentation Group.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

- B. Standard: ASME B40.200.

- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Terice, H. O. Co.
 - g. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus [1] <Insert number> percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install thermometers in the following locations:
 1. Inlet and outlet of each water heater.

3.2 CONNECTIONS

- A. Install meters adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

END OF SECTION 220519

**SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Bronze ball valves.
- 2. Iron, single-flange butterfly valves.
- 3. Bronze lift check valves.
- 4. Bronze swing check valves.

B. Related Sections:

- 1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
- 3. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
- 4. Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
- 5. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: ball, or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: Threaded ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.

END OF SECTION 220523

**SECTION 220529
HANGERS & SUPPORTS FOR PLUMBING PIPING & EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 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. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ERICO International Corporation.
 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 3. Piping Technology & 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.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
5. 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 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide 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 099123 "Interior Painting."

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and stainless-steel] attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. 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.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

**SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.

5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 incheshigh.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

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 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: Black.
 - 2. Sanitary Waste Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - 2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

**SECTION 220719
PLUMBING 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 plumbing piping services:
 - 1. Domestic hot-water piping.
 - 2. Domestic recirculating hot-water piping.
 - 3. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment 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).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 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.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1.7 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. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Owens Corning; Fiberglas Pipe Insulation.
 - 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.
- G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eagle Bridges - Marathon Industries; 225.
 - b. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.4 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.5 SECUREMENTS

- A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with closed seal.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. McGuire Manufacturing.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. 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] [4 inches]** o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 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. 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.
 8. 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 MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 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.

3.9 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.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 2-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Condensate Drain:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Polyolefin: 1 inch thick.

END OF SECTION 220719

**SECTION 221116
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.
 - 2. Encasement for piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt 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. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- D. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

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 Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Central Plastics Company.
 - b. Watts; a division of Watts Water Technologies, Inc.
 - c. Wilkins; a Zurn company.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" 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 shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level and plumb.
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. 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.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "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," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 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 2 and Smaller: 6 feet inches with 3/8-inch rod.
 2. NPS 2 and NPS 2-1/2: 8 feet inches with 1/2-inch rod.
 3. NPS 4 and Larger: 8 feet with 5/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 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. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.8 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.

3.9 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.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.12 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 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.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

**SECTION 221119
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. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Water-hammer arresters.
9. Trap-seal primer valves.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Powers; a division of Watts Water Technologies, Inc.
 - b. Symmons Industries, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Powers; a division of Watts Water Technologies, Inc.
 - b. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Piping Finish: Copper.
9. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
6. Drain: Pipe plug.

2.7 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Mounting: Recessed.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. IPS Corporation.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 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: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
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.

2.9 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products, Inc.
 - b. Watts Drainage Products.
 - c. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.10 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

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-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. 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.
- E. Install Y-pattern strainers for water on supply side of each control valve.
- 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 Section 061000 "Rough Carpentry."
- G. Install water-hammer arresters in water piping according to PDI-WH 201.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

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. Pressure vacuum breakers.
 2. Calibrated balancing valves.
 3. Primary, thermostatic, water mixing valves.
 4. Primary water tempering valves.
 5. Outlet boxes.
 6. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Test each double-check, backflow-prevention assembly 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 flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

**SECTION 221123
FACILITY 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. Concrete bases.

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 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 2. Service Regulators: 65 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
1. Piping specialties.
 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 1. Notify Construction Manager 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.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 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.

2.2 PIPING SPECIALTIES

- A. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- B. 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.

2.3 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.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McDonald, A. Y. Mfg. Co.
 - b. Nibco.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.

6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. 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 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.

2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pacific Seismic Products, Inc.
2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 0.5 psig.
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.6 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 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Meter Company.
 - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5psig.

2.7 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. 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.

- C. Install fittings for changes in direction and branch connections.

3.4 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 piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- N. 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.
- O. 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 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.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.5 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.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 2 and Smaller: Maximum span, 6 feet; minimum rod size, 3/8 inch.
 - 2. NPS 2-1/2 to NPS 3-1/2: Maximum span, 8feet; minimum rod size, 1/2 inch.
 - 3. NPS 4 and Larger: Maximum span, 8feet; minimum rod size, 5/8 inch.

3.8 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 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.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

3.10 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.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be one of the following:
 - 1. Galvanized steel pipe with galvanized steel malleable-iron fittings and threaded joints.
 - 2. Galvanized steel pipe with galvanized wrought-steel fittings and welded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground piping NPS 2 and smaller shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground piping NPS 2-1/2 and larger shall be the following:
 - 1. Steel pipe with wrought-steel fittings and welded joints.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Piping valves shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 221123

**SECTION 221316
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.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT 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 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.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Tyler Pipe.
 2. Standards: ASTM C 1277 and CISPI 310.
 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 2. Standards: ASTM C 1277 and ASTM C 1540.
 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. 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. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- O. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

- A. 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.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install stainless-steel pipe hangers for horizontal piping.
 - 2. Install stainless-steel pipe support clamps for vertical piping.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting 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. 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. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.4 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 drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. 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.

3.5 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 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 drainage 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.7 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 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 the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

END OF SECTION 221316

**SECTION 221319
SANITARY WASTE PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Through-penetration firestop assemblies.
 - 4. Miscellaneous sanitary drainage piping specialties.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Smith, Jay R. Mfg. Co.
 - 2) Tyler Pipe.
 - 3) Zurn Plumbing Products Group.
 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 3. Size: Same as connected drainage piping
 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Countersunk or raised-head, brass plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Smith, Jay R. Mfg. Co.
 - 2) Tyler Pipe.
 - 3) Watts Drainage Products.
 - 4) Zurn Plumbing Products Group.
 2. Size: Same as connected branch.
 3. Body or Ferrule: Cast iron.
 4. Closure: Brass plug with tapered threads.
 5. Adjustable Housing Material: Cast iron with threads.
 6. Standard: ASME A112.3.1.
 7. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.
 - b. Tyler Pipe; Wade Div.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Not required.
6. Outlet: Bottom.
7. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
8. Top or Strainer Material: Nickel bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Round.
11. Trap Features: Trap-seal primer valve drain connection.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

- a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- B. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- C. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 135 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Assemble open drain fittings and install with top of hub 2 inch above floor.
 - F. Install deep-seal traps on floor drains and other waste outlets larger than NPS 2.
 - G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
 - H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
 - J. Install wood-blocking reinforcement for wall-mounting-type specialties.
 - K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

**SECTION 223400
FUEL-FIRED, DOMESTIC-WATER HEATERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Two years.
 - b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, WATER HEATERS

- A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Description: Manufacturer's proprietary design to provide at least 84 percent combustion efficiency at optimum operating conditions.
4. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

- b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
5. Factory-Installed Storage-Tank Appurtenances:
- a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
 - g. Temperature Control: Adjustable thermostat.
 - h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- B. Capacity and Characteristics: See Water Heater Schedule.

2.2 WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL Inc.
 - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - c. Taco, Inc.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
 - a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: 4 gal. minimum.

- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- D. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- E. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- F. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
- G. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- H. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Anchor domestic-water heaters to substrate.
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters according to NFPA 54.
1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
- D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Fill domestic-water heaters with water.
- I. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 221123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 223400

**SECTION 224213.13
COMMERCIAL WATER CLOSETS**

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 closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.

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 water closets.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

- A. Water Closets: Floor mounted, bottom outlet, top spud.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - 2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.

- b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Rim Contour: Elongated.
 - f. Water Consumption: 1.28 gal. per flush.
 - g. Spud Size and Location: NPS 1-1/2; top.
 - h. Color: White.
- 3. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.
 - 4. Flushometer Valve: See Plumbing Fixture Schedule.
 - 5. Toilet Seat: See Plumbing Fixture Schedule.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sloan Valve Company.
- 2. Standard: ASSE 1037.
- 3. Minimum Pressure Rating: 125 psig.
- 4. Features: Include integral check stop and backflow-prevention device.
- 5. Material: Brass body with corrosion-resistant components.
- 6. Exposed Flushometer-Valve Finish: Chrome plated.
- 7. Panel Finish: Chrome plated or stainless steel.
- 8. Style: Exposed.
- 9. Consumption: 1.28 gal. per flush.
- 10. Minimum Inlet: NPS 1.
- 11. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats: See Plumbing Fixture Schedule.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Church Seats.
 - c. Olsonite Seat Co.
- 2. Standard: IAPMO/ANSI Z124.5.
- 3. Material: Plastic.
- 4. Type: Commercial (Standard).
- 5. Shape: Elongated rim, open front.
- 6. Hinge: Self-sustaining, check.
- 7. Hinge Material: Noncorroding metal.
- 8. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

- 1. Install level and plumb according to roughing-in drawings.
- 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Support Installation:

- 1. Use carrier supports with waste-fitting assembly and seal.

C. Flushometer-Valve Installation:

- 1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
- 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- 3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

- 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
- 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- 3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

- 1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
- 2. Match sealant color to water-closet color.
- 3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

**SECTION 224213.16
COMMERCIAL URINALS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Urinals.
 - 2. Flushometer valves.

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 urinals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one six of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

- A. Urinals: Wall hung, back outlet, siphon jet, accessible.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - 2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.

- c. Type: Siphon jet.
 - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - e. Water Consumption: Water saving.
 - f. Spud Size and Location: NPS 3/4; top.
 - g. Outlet Size and Location: NPS 2; back.
 - h. Color: White.
- 3. Flushometer Valve: See Plumbing Fixture Schedule.
 - 4. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - b. Size: NPS 2.
 - 5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sloan Valve Company.
- 2. Standard: ASSE 1037.
- 3. Minimum Pressure Rating: 125 psig.
- 4. Features: Include integral check stop and backflow-prevention device.
- 5. Material: Brass body with corrosion-resistant components.
- 6. Exposed Flushometer-Valve Finish: Chrome plated.
- 7. Panel Finish: Chrome plated or stainless steel.
- 8. Style: Exposed.
- 9. Consumption: 0.5 gal. per flush.
- 10. Minimum Inlet: NPS 3/4.
- 11. Minimum Outlet: NPS 1-1/4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

**SECTION 224216.13
COMMERCIAL LAVATORIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Lavatories.
2. Faucets.

- B. Related Requirements:

1. Section 224300 "Medical Plumbing Fixtures" for healthcare lavatories.

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 lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory: Vitreous china, wall mounted, with back.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Standard America.
 - b. Kohler Co.
- 2. Fixture: See Plumbing Fixture Schedule
- 3. Faucet: See Plumbing Fixture Schedule.
- B. Lavatory: Wheelchair, vitreous china, wall mounted.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - 2. Fixture: See Plumbing Fixture Schedule.
 - 3. Faucet: See Plumbing Fixture Schedule.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: See Plumbing Fixture Schedule.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Chicago Faucets.
 - 2. Standard: ASME A112.18.1/CSA B125.1.
 - 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

2.3 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: See Plumbing Fixture Schedule.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Chicago Faucets.
 - 2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

2.4 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Chronomite Laboratories, Inc.; a division of Acorn Engineering Company.
- C. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.5 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.

2.6 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2 by NPS 1-1/4.
 - 2. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures by McGuire on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

**SECTION 224216.16
COMMERCIAL SINKS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Service sinks.
 - 2. Utility sinks.
 - 3. Sink faucets.
 - 4. Laminar-flow, faucet-spout outlets.
 - 5. Supply fittings.
 - 6. Waste fittings.

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 sinks.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

- A. Service Sinks: Enameled, cast iron, floor mounted.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Commercial Enameling Company.
- 2. Fixture: See Plumbing Fixture Schedule

2.2 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing.
- 2. Fixture: See Plumbing Fixture Schedule
- 3. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Loose key.
 - 2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe.
- 4. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2.
 - 2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
 - 3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
- 5. Mounting: On counter with sealant.

2.3 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: See Plumbing Fixture Schedule.
 - 1. Commercial, Solid-Brass Faucets.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Chicago Faucets.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.

2.4 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Chronomite Laboratories, Inc.
- C. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.5 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.

2.6 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap: See Plumbing Fixture Schedule.

2.7 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Set floor-mounted sinks in leveling bed of cement grout.
- C. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures by McGuire on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

**SECTION 224713
DRINKING FOUNTAINS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains: Stainless steel, wall mounted.
 - 1. Stainless-Steel Drinking Fountains:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkay Manufacturing Co.
 - 2) Haws Corporation.
 - 2. Standards:
 - a. Comply with NSF 61.
 - 3. Type Receptor: On horizontal support.
 - 4. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - 5. Bubblers: Two, with adjustable stream regulator, located on deck.
 - 6. Control: Push button.
 - 7. Drain: Grid type with NPS 1-1/4 tailpiece.
 - 8. Supply: NPS 3/8 with shutoff valve.
 - 9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
 - 10. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

**SECTION 230500
COMMON WORK RESULTS 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. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
 2. Mechanical sleeve seals.
 3. Sleeves.
 4. Escutcheons.
 5. Grout.
 6. HVAC demolition.
 7. Equipment installation requirements common to equipment sections.
 8. Painting and finishing.
 9. Concrete bases.
 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 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.

C. Electrical Characteristics for HVAC 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. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.

- c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC 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.

3.10 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.

- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

**SECTION 230529
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. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC for vibration isolation devices.
4. 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Fiberglass strut systems.
 4. Pipe stands.
 5. Equipment supports.

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: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.

- d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 3. Standard: Comply with MFMA-4.
 4. Channels: Continuous slotted steel channel with inturred lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, **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.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
 - I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - K. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
 - O. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation 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 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

**SECTION 230548
VIBRATION AND SEISMIC CONTROLS 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. Elastomeric isolation pads.
2. Restrained-spring isolators.
3. Elastomeric hangers.
4. Spring hangers.
5. Restraint channel bracings.
6. Restraint cables.
7. Seismic-restraint accessories.
8. Mechanical anchor bolts.
9. Vibration isolation equipment bases.

B. Related Requirements:

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 1. Refer to structural drawings for all wind and seismic forces associated with this project.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries, Inc.
 - b. Vibrex
 - c. California Dynamics Corporation.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.

2.3 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Restrained, Open-Spring Isolators with Vertical-Limit Stop Restraint: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries, Inc.
 - b. Vibrex
 - c. California Dynamics Corporation.
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.4 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries, Inc.
 - b. Vibrex
 - c. California Dynamics Corporation.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.5 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries, Inc.
 - b. Vibrex
 - c. California Dynamics Corporation.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.6 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.7 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

- B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.8 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO.

- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.10 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mason Industries, Inc.
 2. Vibrex
 3. California Dynamics Corporation.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
 5. Fill base with concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD.

- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by OSHPD that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by OSHPD that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

END OF SECTION

**SECTION 230553
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 indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. 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 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, manufacturer, model number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 incheshigh.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

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 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in other sections.

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
1. Refrigerant Piping:
 - a. Background Color: Orange.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:

- a. All Valve-Tags: 1-1/2 inches minimum, round.
2. Valve-Tag Color:
 - a. All Valve-Tags: Natural.
3. Letter Color:
 - a. All Valve-Tags: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

**SECTION 230593
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.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. TAB: Testing, adjusting, and balancing.
- C. TAB Specialist: An entity engaged to perform TAB Work.

1.4 ACTION SUBMITTALS

- A. LEED Submittals:
 - 1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
 - 2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. 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.

1.6 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Owner.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and 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 filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 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", ASHRAE 111, and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct

Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- 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."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. 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.
 6. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 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.

3.9 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.

3.10 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.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 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. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Position of balancing devices.

- E. 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.
- F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- G. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.11 INSPECTIONS

- A. Initial Inspection:
- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
- 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner.
 3. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

**SECTION 230713
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 insulating the following duct services:
1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.
 3. Indoor, concealed return located in unconditioned space.
 4. Indoor, exposed return located in unconditioned space.
 5. Outdoor, concealed supply and return.
 6. Outdoor, exposed supply and return.
- B. Related Sections:
1. Section 230719 "HVAC Piping Insulation."
 2. Section 233113 "Metal Ducts" for duct liners.

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. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 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 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 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.

1.8 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.

- d. Knauf Insulation; Insulation Board.
- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- ### A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- ### B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.8 TAPES

- ### A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
- 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

- 1. 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.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.

- 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.

- 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

2.10 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

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 ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.8 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 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 for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Outdoor, concealed supply and return.
 - 6. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, supply-air duct and plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. Ft. nominal density.
 - 2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0-lb/cu. Ft. nominal density.
- B. Concealed, return-air duct and plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. Ft. nominal density.
 - 2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0-lb/cu. Ft. nominal density.
- C. Concealed, outdoor-air duct and plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. Ft. nominal density.
 - 2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0-lb/cu. Ft. nominal density.

- D. Exposed, supply-air duct and plenum insulation shall be the following:
 - 1. Internally lined per Section 233113 "Metal Ducts."
- E. Exposed, return-air duct and plenum insulation shall be the following:
 - 1. Internally lined per Section 233113 "Metal Ducts."
- F. Exposed, outdoor-air duct and plenum insulation shall be the following:
 - 1. Internally lined per Section 233113 "Metal Ducts."

3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Outdoor, supply-air duct and plenum insulation shall be the following:
 - 1. Internally lined per Section 233113 "Metal Ducts."
- C. Outdoor, return-air duct and plenum insulation shall be the following:
 - 1. Internally lined per Section 233113 "Metal Ducts."
- D. Outdoor, outdoor-air duct and plenum insulation shall be the following:
 - 1. Internally lined per Section 233113 "Metal Ducts."

END OF SECTION 230713

**SECTION 230719
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. Refrigerant piping, indoors and outdoors.

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. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 3. Detail removable insulation at piping specialties.
 - 4. Detail application of field-applied jackets.

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.
- C. Coordinate installation and testing of heat tracing.

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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and 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. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. 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.
- N. 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 Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 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.

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.
- E. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- F. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- G. Do not field paint aluminum or stainless-steel jackets.

3.7 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, and three locations of fittings 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.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.

END OF SECTION

**SECTION 23 08 00
COMMISSIONING OF HVAC**

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 commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R systems, subsystems, and equipment Testing Procedures

- A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

- B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 2. Description of equipment for flushing operations.
 3. Minimum flushing water velocity.
 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- C. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas and heating hot-water systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls..

END OF SECTION 230800

**SECTION 232300
REFRIGERANT PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Hot-Gas and Liquid Lines: 535 psig.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8.

2.2 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.

- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- J. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- K. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Liquid lines may be installed level.
- M. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- O. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BA_g, cadmium-free silver alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Verify that compressor oil level is correct.
 - 2. Open compressor suction and discharge valves.
 - 3. Open refrigerant valves except bypass valves that are used for other purposes.
 - 4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

**SECTION 233113
METAL DUCTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
- 2. Single-wall round ducts and fittings.
- 3. Sheet metal materials.
- 4. Duct liner.
- 5. Sealants and gaskets.
- 6. Hangers and supports.
- 7. Seismic-restraint devices.

B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
- 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

- 1. Liners and adhesives.
- 2. Sealants and gaskets.
- 3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. 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 D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.

- b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
- 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. 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.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-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.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Mason Industries.
 - 5. TOLCO; a brand of NIBCO INC.
 - 6. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for

restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" and ASCE/SEI 7.
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.

- E. Install seismic-restraint devices using methods approved by the Office of Statewide Health Planning and Development for the State of California.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

- a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Supply Ducts:
 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
- C. Return Ducts:
 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
 - a. Pressure Class: Positive or negative 1-inch wg.
- D. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
- F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1-1/2 inches thick.
2. Return Air Ducts: Fibrous glass, Type I, 1-1/2 inches thick.
3. Supply Fan Plenums: Fibrous glass, Type II, 1-1/2 inches thick.
4. Return-Fan Plenums: Fibrous glass, Type II, 2 inches thick.
5. Transfer Ducts: Fibrous glass, Type I, 1-1/2 inches thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 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 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.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

**SECTION 233300
AIR DUCT ACCESSORIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Fire dampers.
 - 4. Combination fire and smoke dampers.
 - 5. Flange connectors.
 - 6. Turning vanes.
 - 7. Remote damper operators.
 - 8. Duct-mounted access doors.
 - 9. Flexible connectors.
 - 10. Flexible ducts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - 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.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff.

3. Ruskin Company.
 - B. Description: Gravity balanced.
 - C. Maximum Air Velocity: 2500 fpm.
 - D. Maximum System Pressure: 2-inch wg.
 - E. Frame: Hat-shaped, 18-gage galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
 - F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
 - G. Blade Action: Parallel.
 - H. Blade Seals: Extruded vinyl, mechanically locked.
 - I. Blade Axles:
 1. Material: Plated steel.
 2. Diameter: 0.20 inch.
 - J. Tie Bars and Brackets: Galvanized steel.
 - K. Return Spring: Adjustable tension.
 - L. Bearings: Synthetic pivot bushings.
 - M. Accessories:
 1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.
 3. Chain pulls.
 4. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 5. Screen Mounting: Rear mounted.
 6. Screen Material: Galvanized steel.
 7. Screen Type: Bird.
 8. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Nailor Industries Inc.
 - b. Pottorff.
 - c. Ruskin Company.
 - d. Trox USA Inc.
- 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 20-gage, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 - 6. Blade Axles: Plated steel.
 - 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.

2.5 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff.
 - 3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

- F. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Blades: Roll-formed, horizontal, interlocking, 16-gage, galvanized sheet steel.
- I. Leakage: Class II.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: Two-position action.
- N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- O. Accessories:
 - 1. Test and reset switches, remote mounted.

2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.

2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.
 4. SEMCO Incorporated.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. 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.
- D. 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."
- E. Vane Construction: Double wall.

2.8 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff.
 2. Ventfabrics, Inc.
 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Galvanized spiral wire sheath.

- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Steel.

2.9 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Pottorff.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
 - 1. Door and Frame Material: Galvanized sheet steel.
 - 2. Door: Single wall or double wall with insulation fill with metal thickness applicable for duct pressure class.
 - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 - 4. Factory set.
 - 5. Doors close when pressures are within set-point range.
 - 6. Hinge: Continuous piano.
 - 7. Latches: Cam.

8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 11-gage carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd..

2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd..
 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.12 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, polyethylene film supported by helically wound, galvanized-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 5500 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

- C. Flexible Duct Connectors:
 - 1. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.

5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. At each change in direction and at maximum 50-foot spacing.
 8. Upstream from turning vanes.
 9. Upstream or downstream from duct silencers.
 10. Control devices requiring inspection.
 11. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- M. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with draw bands.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

**SECTION 233423
HVAC POWER VENTILATORS**

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. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.

2. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

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. Belts: One set(s) for each belt-driven unit.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [Greenheck Fan Corporation](#).
 2. [Loren Cook Company](#).
 3. [PennBarry](#).

- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
 - 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
 - 1. Resiliently mounted to housing.
 - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 5. Fan and motor isolated from exhaust airstream.
- E. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Built-in cant and mounting flange.
 - 2. Overall Height: 12 inches.
 - 3. Pitch Mounting: Manufacture curb for roof slope. Field verify prior to ordering
 - 4. Metal Liner: Galvanized steel.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

**SECTION 233713
DIFFUSERS, REGISTERS, AND GRILLES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Square, cone ceiling diffusers.
2. Adjustable bar grilles.

- B. Related Sections:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square Cone Ceiling Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. Titus.
 - c. Anemostat Products; a Mestek company.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, color selected by Architect.
5. Face Style: Square Cone.
6. Mounting: T-Bar.
7. Pattern: Adjustable.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Price Industries.
 - b. Titus.
 - c. Anemostat Products; a Mestek company.
2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Mounting: Concealed.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

**SECTION 233723
HVAC GRAVITY VENTILATORS**

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. Roof hoods.
 - 2. Goosenecks.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Ventilators, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. For louvered-penthouse ventilators specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

- B. LEED Submittals:
 - 1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
- C. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof framing plans 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 roof curbs and ventilators will be attached.
 - 2. Sizes and locations of roof openings.
- B. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent.
 2. Greenheck Fan Corporation.
 3. Loren Cook Company.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Built-in cant and mounting flange.
 2. Overall Height: 12 inches.
- E. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.
- F. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
- G. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
 3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 GOOSENECKS

- A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 6-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.
- B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Built-in cant and mounting flange.
 2. Overall Height: 18 inches.
- C. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.
- D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

E. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.
- C. Install gravity ventilators with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 237413
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. Gas furnace.
 - 3. Economizer outdoor- and return-air damper section.
 - 4. Integral, space temperature controls.
 - 5. 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.

H. VVT: Variable-air volume and temperature.

1.4 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. Wind and 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.

1.5 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 Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified 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 calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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. 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.
- D. Field quality-control test reports.
- E. Warranty: Special warranty specified in this Section.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For RTUs to include in emergency, 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. Fan Belts: One set for each belt-driven fan.
 2. Filters: One set] of filters for each unit.
- 1.8 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.

1.9 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. Trane; American Standard Companies, Inc.
 - 3. YORK International Corporation.

2.2 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.
- B. 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: 0.052 inch thick.

- C. Inner Casing Fabrication Requirements:
 - 1. Inside Casing: Galvanized steel, 0.034 inch thick.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I.
 - 2. Thickness: 1/2 inch
 - 3. 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.
 - 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of galvanized steel sheet, a minimum of 2 inches deep, and 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.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

- A. Direct-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, ECM motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- C. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- D. 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 defined in Section 230548 "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.
- E. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

- A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved 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. Coil Split: Interlaced.
4. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections complying with ASHRAE 62.1.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: [One] [Two] <Insert number>.
- B. Compressor: Hermetic, scroll], mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.
- C. 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.
 11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
 12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Pleated: Minimum 90 percent arrestance, and MERV 11.

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.
- B. Burners: Stainless steel.
 1. Fuel: Natural gas.

2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
- C. Heat-Exchanger and Drain Pan: Stainless steel.
- D. Venting: Gravity vented.
- E. Safety Controls:
1. Gas Control Valve: Two stage.
 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 DAMPERS

- A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
1. Damper Motor: Modulating with adjustable minimum position.
 2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC."
- B. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
 2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
 3. Provide BACnet or LonWorks compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
 - d. Monitoring occupied and unoccupied operations.

- e. Monitoring constant and variable motor loads.
- f. Monitoring variable-frequency drive operation.
- g. Monitoring cooling load.
- h. Monitoring economizer cycles.
- i. Monitoring air-distribution static pressure and ventilation air volume.

2.11 ACCESSORIES

- A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.
- 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.
- D. Hail guards of galvanized steel, painted to match casing.
- E. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

2.12 ROOF CURBS

- A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Wind and 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. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

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. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to 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.

C. Unit Support: Secure RTUs to structural support 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 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 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 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 237413

**SECTION 238126
SPLIT-SYSTEM AIR-CONDITIONERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each air-handling unit.
 - 2. Gaskets: One set for each access door.
 - 3. Fan Belts: One set for each air-handling unit fan.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: One year from date of Substantial Completion.
 - c. For Labor: One year 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; Home Comfort and HVAC Building & Industrial Systems.
 2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 3. Trane; a business of American Standard companies.
 4. YORK; a Johnson Controls company.

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 3. Fan: Direct drive, centrifugal.
 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - f. Mount unit-mounted disconnect switches on exterior of unit.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 6. Filters: Permanent, cleanable.
 7. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 1 inch deep.
 - b. Single-wall, galvanized-steel sheet.

- c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
- d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- 3. Fan: Aluminum-propeller type, directly connected to motor.
- 4. Motor: Permanently lubricated, with integral thermal-overload protection.
- 5. Low Ambient Kit: Permits operation down to 45 deg F.
- 6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."
- B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 - 1. Compressor time delay.
 - 2. 24-hour time control of system stop and start.
 - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 4. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.

- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Drain Hose: For condensate.
- F. Additional Monitoring:
 - 1. Monitor constant and variable motor loads.
 - 2. Monitor variable-frequency-drive operation.
 - 3. Monitor economizer cycle.
 - 4. Monitor cooling load.
 - 5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in other sections.
 - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

**SECTION 26 0501
GENERAL ELECTRICAL REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the general requirements for Division 26 - Electrical.
 - 1. Division 1 and the General Conditions apply to all work of this section.
 - 2. Division 26 supplements the applicable requirements of other Divisions.
- B. The Work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this division, complete, as shown on the drawings and/or specified herein.
 - 1. Examine all divisions for related work required to be included as work under this division.
- C. Owner-furnished items: Pick up Owner-furnished items and handle, deliver, install, and make all final connections.
 - 1. Assume responsibility for the items when consigned at the storage facility in accord with requirements of the Contract Documents.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:
 - 1. ANSI American National Standards Institute
 - 2. ASTM American Society for Testing and Materials
 - 3. IEEE Institute of Electrical and Electronics Engineers
 - 4. NEC National Electrical Code (NFPA 70)
 - 5. NEMA National Electrical Manufacturers Association
 - 6. NFPA National Fire Protection Association
 - 7. UL Underwriters Laboratories, Inc.

1.3 QUALITY ASSURANCE

- A. Regulation: All the electrical equipment and materials, including their installation, shall conform to the following latest applicable codes and standards:

1. National Electrical Code (NEC).
 2. California State Fire Marshal.
 3. Occupational Safety and Health Act (OSHA).
 4. Requirements of Serving Utility Companies.
 5. Local Codes and Ordinances.
 6. Requirements of the California Division of the State (DSA).
 7. California Administrative Code, Title 8, Chapter 4, Industrial Safety Orders.
 8. California Administrative Code, Title 24.
 9. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.
- B. Contractor's Expense: Obtain and pay for all required bonds, insurance, licenses, and pay for all taxes, fees and utility charges required for the electrical work.

1.4 SUBMITTALS

- A. Submit all of the items described in Paragraphs 1, 2, and 3 (below) as a single submittal. Partial submittals will not be accepted. Contractor shall review submittals for conformance with Contract Documents, and make necessary revisions. Contractor shall also verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to adequacy and clear working space. Submit the following in accordance with Division 1, with the additional electrical systems-related document requirements and additional number of copy sets as specified below:
1. Detailed shop drawings and associated product data/material lists (also see applicable technical specification sections following for additional requirements), six submittal document sets, for:
 - a. Medium voltage switchgear
 - b. Substations
 - c. Switchboards
 - d. Panelboards
 - e. Engine generator systems
 - f. Motor control centers
 - g. Lighting control equipment
 - h. Fire alarm system
 - i. Public address/sound systems
 2. Contractor shall submit shop drawings sealed by a Structural Engineer registered in the State of California to demonstrate compliance with the following:
 - a. Component Anchorage Requirements:
 - 1) All mechanical, plumbing, and electrical components shall be anchored and installed per the details on the DSA approved construction documents. Where no detail is indicated, the following components shall be anchored or braced to meet the force and displacement requirements prescribed in the 2010

CBC. Sections 1615A.1.12 through 1615A.1.22 and ASCE 7-05 Chapter 6 and 13:

- a) All permanent equipment and components.
 - b) Temporary or movable equipment that is permanently attached (e.g. hard wired) to the building utility services such as electricity, gas or water.
 - c) Movable equipment which is stationed in one place for more than 8 hours and heavier than 400 pounds are required to be anchored with temporary attachments.
- 2) The attachments of the following mechanical and electrical components shall be positively attached to the structure but need not be detailed on the plans. These components shall have flexible connections provided between the component and associated ductwork, piping and conduit:
- a) Components weighing less than 400 pounds and have a center of mass located 4 feet or less above the adjacent floor or roof level that directly support the component.
 - b) Components weighing less than 20 pounds, or in the case of distributed systems, less than 5 pounds per foot which are suspended from a roof or floor or hung from a wall.
- 3) For those elements that do not require details on the approved drawings, the installation shall be subject to the approval of the Structural Engineer of Record and the DSA District Structural Engineer. The project inspector will verify that all components and equipment have been anchored in accordance with above requirements.
- b. Piping, Ductwork, and Electrical Distribution System Bracing requirements:
- 1) Piping, ductwork, and electrical distribution systems shall be braced to comply with the forces and displacements prescribed in ASCE 7-05 Section 13.3 as defined in ASCE 7-05 Section 13.6.8, 13.6.7, 13.6.5.6, and 2010 CBC, Section 1615A.1.20, 1615A.1.21 and 1615A.1.22.
 - 2) The bracing and attachments to the structure shall be detailed on the approved drawings or they shall comply with one of the OSHPD Pre-Approvals (OPA #) as modified to satisfy anchorage requirements of ACI 318, Appendix D.
 - 3) Copies of the manual shall be available on the jobsite prior to the start of hanging and bracing of the pipe, ductwork, and electrical distribution systems.
 - 4) The Structural Engineer of Record shall verify the adequacy of the structure to support the hanger and brace loads.
3. Product data/material lists (also see applicable technical specification sections following for additional requirements), at least six submittal

document sets, for:

- a. Raceways
- b. Cable trays
- c. Underground duct and fittings
- d. Precast concrete pullboxes
- e. Building wire and cable
- f. Medium voltage cable
- g. Cabinets, boxes and fittings
- h. Wiring devices
- i. Grounding components
- j. Supporting devices
- k. Nameplates and identification markers/labels
- l. Enclosed circuit breakers
- m. Overcurrent protective devices
- n. Enclosed switches
- o. Enclosed transfer switches
- p. Enclosed motor controllers
- q. Transformers
- r. Lighting fixtures and associated equipment
- s. Lighting system control equipment and devices

4. Substitutions

Catalog numbers and specific brands or trade names followed by designation "or equal" are used in conjunction with material and equipment required by the Specifications to establish the standards of quality, utility, and appearance required. Substitutions which are equal in quality, safety, and appearance to those specified may be accepted, subject to the following provisions:

- a. All substitutions must be submitted in writing to the Owner. Contractor shall submit to the Owner a typewritten list containing a description of each proposed substitute material or equipment.
- b. The Owner will accept, in writing, proposed substitutions that are, in the Owner's opinion, equal in quality, utility and appearance to the material or equipment specified. Such acceptance shall not relieve Contractor from complying with the requirements of the Drawings and the Specifications.
- c. Contractor shall be responsible for all costs of any changes resulting from Contractor's proposed substitutions which affect other parts of the Work or the work of separate Contractors.
 - 1) Contractor also agrees to compensate the Owner for time and expenses spent reviewing substitutions.
- d. The decision of the Owner shall be final.

5. Submit protective device coordination and short circuit calculations conducted and documented to demonstrate: (1) selective coordination, and (2) that electrical equipment and protective devices proposed provide adequate interrupting and withstand capability. The written calculation

procedures and tabulated results shall be bound and submitted - six submittal document sets. Section 26 0573 "Protective Device Coordination and Short Circuit Study", is applicable as included in these Specifications.

6. Submit test results (also see applicable technical specification sections following for additional requirements), six submittal document sets, for:
 - a. Transformers
 - b. Ground fault protection coordination
 - c. Engine generator system
 - d. Fire alarm system
 - e. Public address/sound system

7. Submit operating, maintenance and instructional data (also see applicable technical specification sections following for additional requirements), six submittal document sets, for:
 - a. Switchboards
 - b. Engine generators
 - c. Transfer switches
 - d. Fire alarm system
 - e. Public address/sound system

8. Instruction Materials (also see applicable technical specification sections following for additional requirements), six submittal document sets, for:
 - a. Provide prior to the time of the personnel instruction period, instruction manuals associated with all systems listed above.
 - b. Include the following information, as a minimum, in each copy of the instruction manual:
 - 1) Manufacturers' names and addresses.
 - 2) Serial numbers of items furnished.
 - 3) Catalog cuts, exploded views and brochures, complete with technical and performance data for all equipment, marked to indicate actual items furnished and the intended use.
 - 4) Recommended maintenance procedures.

B. Project record documents:

1. Mark Record Documents daily to indicate all changes made in the field.
 - a. In addition to general requirements of Record Documents, indicate on Project Record Drawings all changes of equipment locations and ratings, fuse sizes, trip sizes and settings on magnetic-only circuit breakers.
 - b. Alterations in raceway runs and sizes, changes in wire sizes, circuit designations, installation details, one line diagrams, control diagrams and schedules.

2. Use green to indicate deletions and red to indicate additions.
 - a. Use the same symbols and follow as much as possible the same

drafting procedures used on the Contract Drawings.

3. Locate conduit stubbed-out for future use, underground feeder conduits, and feeder pull box locations using building lines by indicating on the Project Record Drawings.

1.5 OPERATING AND MAINTENANCE MANUALS

- A. Prepare and submit Operating and Maintenance Manuals, six document sets. In addition to the requirements specified in Division 1 (also see technical specification sections following for additional requirements), include the following information for equipment items:
 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers and replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and, as required, summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.

1.6 QUALITY ASSURANCE

- A. As a minimum Specification requirement, all materials and methods shall comply with applicable governing codes.
- B. Material and equipment substitution.
 1. Equipment other than that specified will be accepted only when written approval is given by the Owner, in accordance with Division 1.
 2. The Contractor shall be held responsible for all physical changes in piping, equipment, etc. resulting from equipment substitution and likewise bear any increased cost of other trades in making said substitution. Approval by the Owner of equipment other than that specified does not relieve the Contractor of this responsibility.

1.7 OWNER'S INSTRUCTIONS

- A. Prior to completion of the contract, and at the Owner's convenience, instruct verbally and demonstrate to the Owner's personnel, the operation of the systems as listed in Part 1 above.

1.8 SYSTEM STARTUP

- A. Do not energize or place electrical equipment in service until all relevant parties have been duly notified and are present or have waived their rights to be present. Where equipment to be placed in service involves service or connection from another contractor of the Owner, notify the Owner in writing when the equipment will be ready. Notify the Owner's Representative two weeks in advance of the date the various times of equipment will be complete.

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site verification of conditions: Contractor shall survey the entire project site and become thoroughly familiar with actual existing conditions. The intent of the work is shown on the drawings and described hereinafter. By the act of participation in the pre-bid conference and site inspection tour specified in the applicable Division 1 section, the Contractor shall be deemed to have made such a study and examination and to accept all conditions present at the site. No request for additional payment shall be considered as valid, due to failure to allow for conditions which may exist.
- B. Electrical work shown: Electrical drawings are generally diagrammatic. Verify equipment sizes with shop drawings and manufacturers' data and coordinate location layout with other trades. Report immediately to the Owner any conflicts in the drawings and specifications with any code or between the electrical work and the work of other trades. No work shall be commenced where a conflict exists prior to receiving proper instructions. Any work or materials shown on the drawings and not mentioned in this division, or vice-versa, shall be executed the same as if specifically mentioned by both. Notify the Owner of any changes of location requirements prior to installation.

3.2 SEISMIC BRACING

- A. Contractor shall be responsible for anchors and connections of electrical work to building structure to prevent damage as a result of earthquake, including manufactured equipment, the connection and integrity of shop-fabricated and field-fabricated materials and equipment. All building equipment and connections therefore shall be designed to resist seismic forces in conformance with Title 24 of the California Administrative Code.

Contractor shall submit shop drawings sealed by a Structural Engineer registered in the State of California to demonstrate compliance with the following requirements:

1. Electrical equipment: For requirements, see Part 1 above.
2. Raceway: All raceway shall be supported and braced per SMACNA "Guidelines for Seismic Restraint Systems and Plumbing Piping Systems." (See Table 23-P of Title 24 for limitations.)

3.3 PENETRATION SEALING

- A. Seal penetrations through exterior walls and fire rated walls, floors, and ceilings. Sealing methods used shall be in compliance with the requirements of the Authority Having Jurisdiction to maintain required fire ratings, and shall be in accordance with the applicable sections in Division 7 which prescribe applicable firestopping and weatherproofing of wall, floor, ceiling, and roof penetrations. Seal all conduit penetrations through roofs.

3.4 DEMOLITION, ALTERATION AND EXTENSION WORK

- A. Provide and perform demolition, alteration, extension, preparatory and miscellaneous work as indicated.
- B. Existing Conditions: Make a detailed survey of the existing conditions pertaining to the work. Check the locations of all existing structures equipment, wiring, etc. include all demolition, alteration and extension work in bid.

3.5 SERVICE INTERRUPTIONS AND UTILITY

- A. Coordinate with the Owner any interruption of services necessary to accomplish the work.
- B. Coordinate with the utility company all work associated with power and communications/ signal distribution systems and service entrance equipment.

3.6 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Perform all necessary tests required to ascertain that the electrical system has been properly installed, that the power supply to each item of equipment is correct, and that the system is free of grounds, ground faults, and open circuits, that all motors are rotating in the proper directions, and such other tests and adjustments as may be required for the proper completion and operation of the electrical system.
 - 2. Test the input and output voltage of each transformer prior to operation under load, and adjust the output voltage by resetting taps, to achieve the specified values. After the system has been placed under load, test transformers under normal operation. Record the measurement of primary and secondary voltages. Reset taps to within 1/2% if necessary to adjust secondary voltage. Submit a report indicating the final result of such tests, and reporting specific current and voltage measurements to the Owner's Representative.
 - 3. If, during the course of testing, it is found that system imbalance is in excess of 20%, rearrange single-pole branch circuits in lighting and receptacle panels to bring system balance within 20% on all phases. Record all such changes on the panelboard schedule and submit a summary of changes to the Owner's Representative.

3.7 CLEANING

- A. Clean exterior surfaces of equipment and remove all dirt, cement, plaster and other debris. Protect interior of equipment from dirt during construction and clean thoroughly before energizing.
- B. Clean-out cracks, corners and surfaces on equipment to be painted, remove grease and oil spots so that paint may be applied without further preparation.
- C. Locate underground conduit stubbed-out for future use, underground feeder conduits, and feeder pull box locations, using building lines by indicating on the Project Record Drawings.

END OF SECTION 260501

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes wire and cable systems rated 600 volts and less:
 - 1. Building wire and cable.
 - 2. Underground feeder and branch circuit cable.
 - 3. Service entrance cable.
 - 4. Armored cable
 - 5. Metal-Clad cable.
 - 6. Nonmetallic-sheathed cable.
 - 7. Wiring connectors and connection accessories.

- B. Cabling requirements in this Section may be supplemented in other sections of these specifications.

- C. Related Sections:
 - 1. General electrical requirements: Section 260501.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

- B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:
 - 1. ANSI American National Standards Institute
 - 2. ASTM American Society for Testing and Materials.
 - 3. Institute of Electrical and Electronics Engineers.
IEEE Standard 82 Test Procedures for Impulse Voltage Tests on Insulated Conductors.
 - 4. NEC National Electrical Code (NFPA 70).
 - 5. NECA National Electrical Contractors Association: "Standard of Installation."
 - 6. National Electrical Manufacturers Association/Insulated Cable Engineers Association
 - NEMA/ICEA WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - NEMA/ICEA WC-7 Cross-Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - NEMA/ICEA WC-8 Ethylene-Propylene-Rubber-Insulated Wire and

Cable for the Transmission and Distribution of
Electrical Energy.

- 7. NFPA National Fire Protection Association
- 8. Underwriters Laboratories, Inc.
 - UL 4 Armored Cable
 - UL 62 Flexible Cord and Fixture Wire.
 - UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
 - UL 486B Wire Connectors for Use with Aluminum Conductors
 - UL 83 Thermoplastic-Insulated Wires and Cables.
 - UL 854 Service Entrance Cables.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Samples: Provide samples upon specific request.
- C. Product Data: Submit product data giving complete description for sizes employed, material types, and electrical ratings.
- D. Certificates:
 - 1. Labels of Underwriters' Laboratories, Inc., fixed to each item of material.
 - 2. If materials are by manufacturers other than those specified submit certification that material meets applicable Underwriters' Laboratories, Inc. Standards.
 - 3. Submit in accordance with Section 260501.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.
- C. Deliver wire and cable to the project in full unbroken cartons or reels marked with conductor size, insulation type, and Underwriters' Laboratories, Inc. label.
- D. Handle wire and cable in a manner to prevent damage to conductor, insulation and identifying markings.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of wiring system prior to rough-in.
- C. Wire and cable routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with requirements, provide products by the following, or equal:

- A. Wire and cable:

Triangle
Anaconda
General Cable Corporation

- B. Connectors:

AMP
Buchanan
Burndy
3M Company
O-Z/Gedney
Thomas & Betts

- C. Insulating Tapes: 3M Company
- D. Wire Ties:
 - Ideal
 - Thomas and Betts ("Ty-Rap")
 - Panduit
- E. Pulling Compound: Ideal ("Yellow 77").

2.2 MATERIALS

- A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed, except as otherwise indicated.
 - 1. Conductor: Copper. Provide solid conductor for No. 10 AWG and smaller. Provide stranded conductors for sizes No. 8 and larger.
 - a. Use stranded conductors:
 - 1) At motors and other applications where subject to vibration.
 - 2) For control circuits.
 - 2. Minimum Size Conductor: No. 12 AWG, except as otherwise indicated.
 - a. Control circuits: No. 14 AWG.
 - 3. Insulation voltage rating: 600 volts.
- B. Building wire and cable:
 - 1. Description: Single conductor insulated wire.
 - 2. Insulation: ANSI/NFPA 70:
 - a. Type THHN/THWN, rated 75 degrees C.
 - b. Type XHHW, rated 90 degrees C.
- C. Service entrance cable:
 - 1. Description: ANSI/NFPA 70. Type USE.
 - 2. Insulation: Type RHW.
- D. Armored cable:
 - 1. Description: ANSI/NFPA 70. Type AC.
 - 2. Insulation: Thermoplastic, 75 degrees C.
- E. Metal-Clad cable:
 - 1. Description: ANSI/NFPA 70. Type MC.

2. Insulation: Thermoplastic, 75 degrees C.
 3. Armor material: Steel.
 4. Armor design: Interlocked metal tape.
 5. Jacket: None.
- F. Nonmetallic-sheathed cable: ANSI/NFPA 70. Type NM and NMC.
- G. Flexible cord and cable: ANSI/NFPA 70. Type SO.
- H. Connectors:
1. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.
- I. Pull Cord: 1/8" polypropylene or nylon.

PART 3 - EXECUTION

3.1 WIRING METHOD

- A. General:
1. Use insulation types suitable for the temperature, moisture and elements to which exposed.
 - a. Minimum 75°C temperature rated insulation on conductors, except as otherwise indicated.
 - 1) Use minimum 90°C temperature rated insulation on conductors in conduits exposed on roof, or where required due to ambient temperature.
 2. Equipment grounding conductors:
 - a. Provide where required by the National Electrical Code, and where indicated. Where conductor size is not indicated, provide size as required by the National Electrical Code.
 - b. Provide for:
 - 1) All branch circuit wiring.
 - 2) All feeders and motor branch circuits
 - 3) All nonmetallic conduits.
 - 4) All flexible metal conduits exceeding 72 inches in length.
 3. Use flexible cords and cables for connection of special equipment as indicated. Length not to exceed 72 inches.

B. Wire and cable connections:

1. Connector types:

- a. No. 10 AWG wire and smaller: Spring-type connectors. All terminations shall be made on device terminals or on terminal blocks.
 - 1) Maximum number of conductors in a connection: 3.
 - b. No. 8 AWG wire and larger: Compression- or pressure-type solderless connectors and terminal lugs. Wrap connection with electrical insulating tape, half-lapped to produce a dielectric value equal to or greater than wire insulation.
2. Provide connector sealing packs for splices that require complete protection from dampness and water where indicated.
 3. Splices in feeders and mains may only be made where designated on the drawings and where prior approval is obtained from Owner.
 4. Location of splices and terminations shall be limited to accessible locations such as outlet boxes, pull boxes, junction boxes, panelboard boxes, and splice boxes.
 5. Insulate taps and splices equal to insulation of adjoining conductor.
 6. Splice or tap permitted only on conductors that are a component part of a single circuit properly protected by approved methods.

3.2 PREPARATION

- A. Examine the system in which the wire is to be installed for defects in equipment and installation which may cause damage to the wire.
- B. Examine wires to be jointed, tapped, spliced, terminated, and their connecting devices for defects which may affect the mechanical and electrical integrity of the connection.
- C. Check conduit systems for damage and loose connections, replace damaged sections. Make sure that the inside of conduit is free of dirt and moisture.
 1. Completely and thoroughly swab raceway before installing wire.
 2. Pull mandrel, one size smaller than the conduit, through entire length of all underground conduits prior to conductor installation.
- D. Do not start work until defects have been corrected and until authorization to proceed has been obtained from Owner's Representative.

3.3 INSTALLATION

- A. Install wire, cable, and connectors in compliance with the NEC.
- B. Install products in accordance with manufacturers instructions.

- C. Install all wire in raceway.
- D. When pulling conductors do not exceed manufacturer's recommended values.
- E. Use polypropylene or nylon ropes for pulling conductors.
- F. Do not bend wire less than the manufacturer's recommended minimum bending radius.
- G. Coordinate cable installation with other work.
- H. Protect exposed cable from damage.
- I. Support cables above accessible ceiling, using spring metal clips or cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
- J. Use suitable cable fittings and connectors.
- K. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound where necessary.
- L. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- M. Conceal all cable in finished spaces.
- N. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.
- O. Keep conductor splices to a minimum.
- P. Clean conductor surfaces before installing connectors.
- Q. Tape uninsulated conductors and connectors with electrical insulating tape to 150 percent of insulation rating of conductor.
- R. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- S. Use splice and tap connectors which are compatible with conductor material.
- T. Provide adequate length of conductors within electrical enclosures and neatly train the conductors to terminal points with no excess. Make terminations so there is no bare conductor at the terminal.
- U. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values. Where

manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

- V. Circuits of multiple phases passing through enclosures shall have phases grouped (bundled together) to reduce the reactance effect.
- W. Arrange conductors in switchboards, panelboards, gutters, boxes, control cabinets and terminal cabinets neatly and lace with black T & B "Ty-Raps" ties.
- X. Connect control circuits as indicated and in accordance with the wiring diagrams furnished by the equipment manufacturer. Control conductors shall be color coded or identified with the provision of non-deteriorating type wire markers.
- Y. Consistently color code wiring continuous throughout the work:
 - 1. Color code secondary service, feeder, and branch circuit conductors with insulation/jacket (factory-applied) color for phase identification as follows:

	-- System Voltage --	
<u>Phase</u>	<u>208Y/120</u>	<u>480Y/277</u>
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

- 2. Select consistent wiring color code for switch legs, travelers, and special systems.
- 3. For conductors No. 6 AWG or larger, permanent plastic colored tape may be used to mark conductor in lieu of color-coded insulation/jacket. Tape shall cover not less than 2 inches of conductor insulation within enclosures.

3.4 IDENTIFICATION

- A. In addition to requirements in Section 260553, the following are applicable:
 - 1. At all switchboard terminations, provide each feeder circuit with a permanent plastic name tag indicating the load fed.
 - 2. Feeders: Identify with the corresponding circuit designation at over-current device and load ends, at all splices and in pull boxes.
 - 3. Branch Circuits: Identify with the corresponding circuit designation at the over-current device and at all splices and devices.
 - 4. Control Wires: Identify with the indicated number and/or letter designation at all terminal points and connections.
 - 5. Alarm and Detection Wires: Identify with the indicated wire and zone numbers at all connection, terminal points, and coiled conductors within cabinets.
 - 6. Conductors Terminated by Others: Indicate location of opposite end of conductor, i.e., Pull Box-Room 101.

7. For identification of conductors use plastic coated self-sticking markers such as Thomas & Betts E-Z Code.
8. Circuit Designation is construed to mean panel designation and circuit number, i.e., LA-13.

3.5 FIELD QUALITY CONTROL

A. Prior to energizing:

1. Inspect wire and cable for physical damage and proper connection.
 - a. Confirm that field-connections made by others in equipment furnished by others are mechanically and electrically sound prior to energization.
2. Confirm electrical continuity and absence of short circuits for all wire and cable with the use of a megohm meter.
 - a. Obtain values for phase-to-phase, phase-to-neutral, and phase-to-ground.
3. Confirm required insulation resistance as follows:
 - a. Perform insulation resistance test for all 600 volt insulated conductors No. 8 AWG and larger.
 - b. Use a 500 volt megger.
 - c. Obtain and record values for insulation resistance to ground and for insulation resistance between each conductor and every other conductor in the same conduit.
 - d. Conductors not complying with the following minimum values of insulation resistance are to be replaced and retested until satisfactory.

<u>Conductor Rated Amperes:</u>	<u>Minimum Insulation Resistance, Ohms:</u>
31 through 50	500,000
51 through 100	250,000
101 through 200	100,000
201 through 400	50,000

- e. Perform tests after conductors have been installed, but before terminal connections have been made. Take readings for each test after the voltage has been applied continuously for one minute.
- f. Perform tests according to manufacturer's recommendations.
- g. Test results shall be in accordance with manufacturer's recommendations.
- h. Correct defects revealed by above tests.

B. Subsequent to wire and cable hook-ups:

1. Energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

END OF SECTION 260519

**SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic materials and methods for grounding and bonding electrical systems and equipment. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1. Grounding electrodes and conductors.
2. Equipment grounding conductors.
3. Bonding.

B. System Requirements

1. Electrical continuity to ground metal raceways and enclosures which are isolated from the equipment ground due to use of conduit or fittings which are nonmetallic (non-conducting), shall be established by providing by a green insulated grounding conductor of approved size within each raceway which shall connect to the isolated metallic raceways or enclosures at supply side. (If bare grounding conductors were specified, connect to enclosure on raceway at both ends.)
2. Cold water or other utility piping systems alone not be used as grounding electrodes due to the use of insulating couplings and nonmetallic pipe in such installation. All grounding electrodes shall be "Made Electrodes" as specified herein.
3. Non-current-carrying metal parts of all high voltage, conduit systems, supports, cabinets and enclosures shall be permanently and effectively grounded.
4. Metallic or semi-conducting shields and lead sheaths of all cables operating at high voltage shall be permanently and effectively grounded at each splice and termination.

C. Related Sections

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. American National Standards Institute.
ANSI C2 National Electrical Safety Code.

2. American Society for Testing and Materials.
 ASTM B3 Soft or Annealed Copper Wire.
 ASTM 33 Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes.
 ASTM B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. Institute of Electrical and Electronics Engineers.
 IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
4. Lightning Protection Code (NFPA 78).
5. NEC National Electrical Code (NFPA 70).
6. NEMA National Electrical Manufacturers Association.
7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.
 UL 467 Electrical Grounding and Bonding Equipment.
 UL 486A Wire Connectors and Grounding Lugs for Use With Copper Conductors.
 UL 96 Lightning Protection Components.

1.3 SUBMITTALS

- A. In addition to this Section, the submittal requirements of Section 260501, "General Electrical Requirements" are applicable.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation. Include specific instructions for preparation and installation of exothermic connectors.
 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260501.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards for grounding and bonding materials and systems. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."

- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with requirements, provide products by the following, or equal:

Anixter Brothers
Blackburn
Burndy
A.B. Chance Co.
Erico Products (CADWELD)
Joslyn
Kearney-National
O-Z/Gedney
Thomas & Betts

2.2 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS

- A. General: Comply with the following, except as otherwise indicated:

- B. Equipment Grounding Conductor: Green insulated copper.
- C. Grounding Electrode Conductor: Stranded copper cable.
- D. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.4 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section, minimum 1/4 inch x 3 inch x 12 inch drilled and tapped every 2 inches on center for two hole lugs.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity plated units.
- C. Bolted Clamps: Heavy-duty units listed for the application.
- D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

2.6 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten-welded to core. Size: 3/4 inch in diameter by 10 feet in length.
- B. Plate Electrodes: Copper plates, minimum 0.10 inch thick, size as indicated.

2.7 TEST (GROUND) WELLS

- A. Precast concrete, 12" round x 18" deep open bottom valve box, with cast iron grate cover plate marked "GROUND."

PART 3 - EXECUTION

3.1 APPLICATION

- A. Equipment Grounding Conductor Application:

Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
 - a. Feeders and branch circuits.
- B. Underground conductors: Soft bare stranded copper, except as otherwise indicated.
 1. Install minimum 4/0 AWG soft stranded copper buried ground loop cable as shown on drawings at least 3 feet below finished grade and minimum 3 feet from building.
- C. Signal and Communications System: Provide #4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.
- D. Separately Derived Systems: Grounding shall be provided in accordance with the NEC, including Article 250.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit.
- F. Service Entrance:
 1. Grounding Conductor: Shall be sized in accordance with National Electrical Code to connect these items to the building bus in the service main equipment.
 2. Equipment Bonding Jumper: Shall be sized in accordance with the National Electrical Code and be conducted on the supply side of the service main equipment.
 3. Grounding Electrode: Bond together the following items to establish the electric service grounding electrode, unless otherwise indicated:
 - a. Minimum 20 feet number 3/0 AWG copper conductor encased in concrete footing or grade beam to contact with earth in two opposite directions.
 - b. Building domestic water service entrance piping on house side of meter; provide bonding jumper across meter.
 - c. Structural steel building framework.
- G. Flexible metal and liquid-tight conduit: Provide equipment grounding conductors.
- H. Rigid nonmetallic conduit: Provide equipment grounding conductors

3.2 INSTALLATION

General: Ground electrical systems and equipment in accordance with NEC requirements except where the drawings or specifications exceed NEC requirements.

- A. Ground Rods: Locate a minimum of one-rod length from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare copper conductors buried at least 24 inches below grade. Connect bare copper cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Use 3/4 inch diameter by 10 foot long ground rods except as otherwise indicated. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.
- B. Metallic Water Service Pipe: Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings. Bond the ground conductor conduit to the conductor at each end.
- C. Ufer System (Concrete-Encased Electrode) Ground: Fabricate with a 20 feet of bare copper conductor laid lengthwise in excavation for foundation or footings. Install so conductor is within 2 inches of the bottom of the concrete. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation. Bond conductor to reinforcing steel at four locations, minimum. Extend conductor below grade and connect to building grounding grid or ground electrode.
- D. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.
- E. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- F. Test Wells: Locate as indicated, and fabricate in accordance with details indicated.
- G. Fences and Gates: See grounding details on the construction drawing for building and fence grounding requirements and details.
 - 1. Use flexible copper braid for bonding the gates of chain link fences.
- H. Cable Shields: Ground shields of any shielded power cable or signal cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer.

3.3 CONNECTIONS

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and

connection methods so metals in direct contact will be galvanically compatible. Make connections with clean bare metal at points of contact.

- B. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Do not alter molds. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare copper grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare copper grounding conductors.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- G. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
- H. Ground Bus Assembly: Make connections to the ground bus assembly in the following manner:
 - 1. Bond cable to two hole lug using exothermic welding process.
 - 2. Bolt two hole lugs to ground bus assembly.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a 3/4 inch diameter by 10 foot long driven ground rod close to the wall and set the rod depth such that 4 inches will extend above the finished floor. Where necessary, install ground rod before the manhole is placed and provide a #4/0 bare tinned-copper conductor from the ground rod into the manhole through a waterproof sleeve in the manhole wall. Protect ground rods passing through concrete floor with a double-wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below the concrete.

Seal floor opening with waterproof nonshrink grout.

- B. Connections at Manholes: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to the ground rod or ground conductor. Make connections with a minimum #2 AWG stranded hard-drawn copper wire. Train conductors plumb or level around corners and fasten to manhole walls. Connect to cable armor and cable shields by means of tinned terminals soldered to the armor or shield, or as recommended by manufacturer of splicing and termination kits.
- C. Grounding System: Ground non-current-carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground copper cable and grounding electrodes arranged as indicated.

3.5 FIELD QUALITY CONTROL

- A. Test all ground fault interrupter (GFI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the two-point method in accordance with Section 9.03 of IEEE 81.
- C. Ground/resistance maximum values shall be as follows:
 - 1. Equipment rated 500 kVA and less: 10 Ohms.
 - 2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.
 - 3. Equipment rated over 1000 kVA: 3 Ohms.
 - 4. Unfenced substations and pad-mounted equipment: 5 Ohms.
 - 5. Manhole and handhole grounds: 10 Ohms.
 - 6. Grounded secondary distribution system neutral and non-current carrying parts associated with distribution systems and grounds not otherwise covered: 25 ohms.
- D. Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated, the provisions of the Contract covering the changes shall apply.
- E. Report: Prepare test reports, certified by the testing organization, of the ground resistance and device function tests at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - 1. Provide copies of reports of all grounding system tests for inclusion in Operation and Maintenance Manuals and for review by the Owner.

END OF SECTION 260526

**SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes:

1. Hangers, straps, clamps, steel channel, and fastening hardware for supporting and anchoring electrical work.

B. Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. NEC National Electrical Code (NFPA 70)
5. NEMA National Electrical Manufacturers Association
6. NFPA National Fire Protection Association
7. UL Underwriters Laboratories, Inc.
8. NECA National Electrical Contractors Association ("Standard of Installation")
9. SMACNA Sheet Metal Air Conditioning Contractors National Association

1.3 SUBMITTALS

A. In addition to this Section, the submittal requirements of Section 260501, "General Electrical Requirements" are applicable.

B. Product Data: Provide manufacturer's catalog data for supporting devices and fastening systems.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instruction for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, "National Electrical Code."
- B. Furnish products listed and classified by Underwriter's Laboratories, Inc. as suitable for purpose specified and shown.

1.5 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.7 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.
- B. Verify supporting device requirements prior to rough-in.
- C. Electrical work is shown on Drawings in approximate locations unless dimensioned. Provide supporting devices as required to complete the electrical work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following, or equal:
 - 1. Hangers, Straps and Beam Clamps:

Appleton
Raco, Inc.

Steel City
O.Z./Gedney Co.
Midland Ross

2. U-Channel Systems, Slotted Metal Angle, and Fittings:

B-Line
Unistrut

3. Anchors:

Acherman-Johnson Corp.
B-Line
Hilti
Phillips Drill Co.
Rawl Products Co.

4. Conduit Sealing Bushings: O-Z/Gedney.

2.2 MATERIAL AND FABRICATION

- A. Coatings: Supports, support hardware, and fasteners shall be protected with zinc coating. Products for use outdoors shall be hot-dip galvanized.
- B. Manufactured supporting devices:
1. Raceway supports: Steel. Clevis hangers, riser clamps, pipe straps, threaded C-clamps with retainers, ceiling trapeze hangers, and wall brackets.
 2. U-Channel systems: 12-gauge steel channels, with 9/16 inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
 3. Fasteners: Types, materials, and construction features as follows:
 - a. Expansion anchors: Carbon steel wedge or sleeve type.
 - b. Toggle bolts: All-steel springhead type.
 - c. Powder-driven threaded studs: Heat-treated steel, designed specifically for the intended service.
 4. Concrete Inserts: Steel, with hot-dipped galvanized finish.
 5. Cable support for vertical conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
 6. Conduit sealing bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

- C. Fabricated supporting devices:
1. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
 2. Steel brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
 3. Pipe sleeves: Provide pipe sleeves of the following:
 - a. Sheet metal: Fabricate from galvanized sheet metal: round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gauge metal for sleeve diameter noted:

3-inch and smaller:	20-gauge.
4-inch to 6-inch:	16-gauge.
Over 6-inch:	14-gauge.
 - b. Steel pipe: Fabricate from Schedule 40 galvanized steel pipe.
 - c. Plastic pipe: Fabricate from Schedule 80 PVC plastic pipe.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide supporting devices to fasten electrical components securely and permanently to the building or structure in accordance with NEC requirements. Install products in accordance with manufacturer's instructions.
- B. Coordinate with the building structural, mechanical, and other systems, and with other electrical installation.
- C. Fastening: Fasten electrical items and their supporting hardware securely to the building structure. Electrical items include, but are not limited to: raceway, cables, cable tray, busway, transformers, panelboards, enclosed switches and motor controllers, control components, boxes, and cabinets.
 1. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.
 2. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams, or to a depth of more than 3/4 inch in concrete shall not cut reinforcing bars. Fill holes that are not used.
 3. Fastening methods:

- a. Wood: Wood screws.
 - b. Hollow masonry units: Toggle bolts.
 - c. Concrete or solid masonry: Concrete inserts or expansion bolts. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts.
 - d. Steel: Machine screws or welded steel studs.
- D. Conductors in vertical raceways: Provide support for wire and cable in riser pull boxes in accordance with NEC Article 300.
- E. Sleeves: Provide in concrete slabs and walls and all other fire-rated floors and walls for raceway and cable installations. For sleeves through fire-rated wall- or floor-construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables. Comply with the requirements of fire-resistant joint sealers in accordance the applicable Division 7 section.
- 1. Conduit seals: Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade as indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

3.2 INSTALLATION, ADDITIONAL REQUIREMENTS FOR RACEWAYS

- A. General: Comply with the NEC and with the following requirements:
- 1. Conform to manufacturer's recommendations for selection and installation of supports.
 - 2. The strength of the support, including attachment to the building or structure, shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
 - a. Raceway shall be supported and braced per SMACNA "Guidelines for Seismic Restraint Systems and Plumbing Piping Systems." (See Footnotes 12 and 13 of Table 23-P of Title 24 for limitations.)
 - 3. Install pipe straps, individual and multiple (trapeze-type) raceway hangers and riser clamps as necessary to support raceways. Provide U-channel and associated pipe channel straps, bolts, clamps, attachments, fasteners, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - a. Raceway run on surface of structure:
 - 1) For conduit run on building surface, use two-hole stamped steel pipe straps.
 - 2) For conduit runs on steel beams, use malleable iron pipe beam clamp bolted to beam.

- b. Raceway suspended from structure:
 - 1) Support parallel runs of horizontal raceways together on trapeze-type hangers.
 - 2) Support individual horizontal raceway by separate pipe hangers.
4. Support spacing: Maximum spacing shall be as allowed by the NEC.
- a. Additional support required at unsupported boxes and access fittings: Support exposed and concealed raceway within 1 foot of an unsupported boxes and access fittings. In horizontal runs, this support may be omitted where box or access fitting is independently supported and raceway termination is not made with chase nipples or threadless box connectors.
 - b. Additional support required for vertical runs: Arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on the raceway terminals. Provide riser clamps for conduit at floor lines.

3.3 INSTALLATION, ADDITION REQUIREMENTS FOR EQUIPMENT AND ENCLOSURES

A. Component Anchorage Requirements:

- 1. All mechanical, plumbing, and electrical components shall be anchored and installed per the details on the DSA approved construction documents. Where no detail is indicated, the following components shall be anchored or braced to meet the force and displacement requirements prescribed in the 2010 CBC. Sections 1615A.1.12 through 1615A.1.22 and ASCE 7-05 Chapter 6 and 13:
 - a. All permanent equipment and components.
 - b. Temporary or movable equipment that is permanently attached (e.g. hard wired) to the building utility services such as electricity, gas or water.
 - c. Movable equipment which is stationed in one place for more than 8 hours and heavier than 400 pounds are required to be anchored with temporary attachments.
- 2. The attachments of the following mechanical and electrical components shall be positively attached to the structure but need not be detailed on the plans. These components shall have flexible connections provided between the component and associated ductwork, piping and conduit:
 - a. Components weighing less than 400 pounds and have a center of mass located 4 feet or less above the adjacent floor or roof level that directly support the component.

- b. Components weighing less than 20 pounds, or in the case of distributed systems, less than 5 pounds per foot which are suspended from a roof or floor or hung from a wall.
 3. For those elements that do not require details on the approved drawings, the installation shall be subject to the approval of the Structural Engineer of Record and the DSA District Structural Engineer. The project inspector will verify that all components and equipment have been anchored in accordance with above requirements.
- B. Piping, Ductwork, and Electrical Distribution System Bracing requirements:
 1. Piping, ductwork, and electrical distribution systems shall be braced to comply with the forces and displacements prescribed in ASCE 7-05 Section 13.3 as defined in ASCE 7-05 Section 13.6.8, 13.6.7, 13.6.5.6, and 2010 CBC, Section 1615A.1.20, 1615A.1.21 and 1615A.1.22.
 2. The bracing and attachments to the structure shall be detailed on the approved drawings or they shall comply with one of the OSHPD Pre-Approvals (OPA #) as modified to satisfy anchorage requirements of ACI 318, Appendix D.
 3. Copies of the manual shall be available on the jobsite prior to the start of hanging and bracing of the pipe, ductwork, and electrical distribution systems.
 4. The Structural Engineer of Record shall verify the adequacy of the structure to support the hanger and brace loads.

3.4 FIELD QUALITY CONTROL

- A. Preparation for tests: Provide all jacks, jigs, fixtures, and calibrated indicating scales required for accurate, reliable testing. Obtain the Owner's Representative and Structural Engineer's approval before transmitting loads to the structure.
 1. Test to 90 percent of rated proof load for fasteners. If fastener fails test, revise all similar fastener installations and re-test until satisfactory results are achieved.
- B. Tests: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
 1. Expansion anchors.
 2. Powder-driven threaded studs.
 3. Toggle bolts.

3.5 CLEANING

- A. Clean surfaces to be painted.

END OF SECTION 260529

**SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes provision of a mechanically- and electrically-complete conduit system including:

1. Rigid metal conduit.
2. Intermediate metal conduit.
3. Electrical metallic tubing.
4. Rigid nonmetallic conduit.
5. Flexible metal conduit.
6. Liquidtight flexible conduit.
7. Wireways (and auxiliary gutters).
8. Surface raceway.
9. Fittings and conduit bodies; accessories.

B. Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

A. American National Standards Institute

1. ANSI C80.1 Specification for Rigid Steel Conduit, Zinc-Coated.
2. ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc-Coated.
3. ANSI C80.5 Rigid Aluminum Conduit.
4. ANSI/NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

B. American Society for Testing and Materials.

1. ASTM 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

C. IEEE Institute of Electrical and Electronics Engineers.

- D. NEC National Electrical Code (NFPA 70).
- E. NECA National Electrical Contractors Association: "Standard of Installation."
- F. National Electrical Manufacturers Association
 - 1. NEMA RN 1 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 2. NEMA TC 2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - 3. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 4. NEMA TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation.
 - 5. NEMA TC 9 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
- G. NFPA National Fire Protection Association
- H. Underwriters Laboratories, Inc.
 - 1. UL 1 Flexible Metal Electrical Conduit
 - 2. UL 6 Rigid Metal Electrical Conduit.
 - 3. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
 - 4. UL 360 Liquidtight Flexible Steel Conduit, Electrical.
 - 5. UL 514B Fittings for Conduit and Outlet Boxes.
 - 6. UL 651 Rigid Nonmetallic Electrical Conduit.
 - 7. UL 797 Electrical Metallic Tubing.
 - 8. UL 1242 Intermediate Metal Conduit

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Product data: For all raceway products.
- C. Contractor shall be responsible for anchors and connections of electrical work to building structure to prevent damage as a result of earthquake, including the connection and integrity of field-fabricated materials and equipment. All building connections therefore shall be designed to resist seismic forces in conformance with Title 24 of the California Administrative Code.
 - 1. Contractor shall submit shop drawings sealed by a Structural Engineer registered in the State of California to demonstrate compliance with the following requirement:
 - a. All raceway shall be supported and braced per SMACNA "Guidelines for Seismic Restraint Systems and Plumbing Piping

Systems.” (See Footnotes 12 and 13 of Table 23-P of Title 24 for limitations.)

- D. Samples: Provide samples upon specific request
- E. Installation instructions: Manufacturer's written installation instructions for [wireway], [surface raceway][, and] [nonmetallic raceway] products. Include instructions for storage, handling, protection, examination, and preparation of Product.
- F. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.
- G. Substitutions: If materials are by manufacturers other than those specified, submit product data giving complete description for sizes employed, material types, and installation methods.
- H. Certificates:
 - 1. Labels of Underwriters' Laboratories, Inc. affixed to each item of material.
 - 2. If materials are by manufacturers other than those specified, submit certification what material meets applicable Underwriters' Laboratories, Inc. Standards.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation".
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in

a manner to prevent damage from the elements, personnel, equipment, and moisture.

- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate with other Work:
 - 1. Install conduits before concrete is placed, and in advance of masonry work.
 - 2. Install conduits through roof in time to be flashed prior to roofing application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with requirements, provide products by the following, or equal:

- A. Conduit Bodies:
 - 1. Adalet-PLM
 - 2. Appleton Electric
 - 3. Carlon
 - 4. Crouse Hinds
 - 5. Killark Manufacturing
 - 6. OZ/Gedney
 - 7. Spring City Electrical Mfg.
- B. Wireway and Auxiliary Gutters:
 - 1. Circle AW
 - 2. Hoffman Engineering
 - 3. Surface Metal Raceway:

4. Alrey-Thompson
5. B-Line
6. Isotrol
7. Square D
8. Wiremold

C. Surface Nonmetallic Raceway:

1. Carlon
2. Hubbell
3. Panduit
4. Wiremold

2.2 METAL CONDUIT AND TUBING

A. Rigid Metal Conduit: Steel, hot-dipped galvanized including the threads, with an outer coating of zinc bichromate, complete with one coupling and one end thread protector, manufactured in accordance with ANSI C80.1 and UL 6.

1. Threaded, hot-dipped galvanized fittings manufactured in accordance with ANSI C80.4.
2. Where indicated, provide galvanized rigid steel conduit and fittings with polyvinyl chloride (PVC) coating of nominal .020 inch (20 mil) thickness conforming to NEMA Standard No. RN-1, Type A, Robroy Industries, or equal.

B. Intermediate Metal Conduit: Hot-dipped galvanized steel including the threads, manufactured in accordance with UL 1242.

C. Electrical Metallic Tubing: Welded, electro-galvanized thin wall steel tubing, manufactured in accordance with ANSI C80.3 and UL 797.

1. Maximum size shall be 2 inches.
2. Provide compression type fittings in all areas.
 - a. Gland compression type, zinc plated steel body, cadmium plated malleable iron nut, O-Z/Gedney
 - b. Indenter type or set screw fitting are not acceptable.

D. Flexible metal Conduit: Hot-dipped galvanized steel interlocking, single-strip type manufactured in accordance with UL1.

1. Squeeze type, malleable iron, cadmium plated, straight and angle connectors for all sizes and twist-in connectors for 1/2-inch and 3/4-inch flexible metal conduit.
2. Integral copper ground wire on sizes 1-1/4" and smaller.

E. Liquidtight Flexible Conduit: Hot-dipped galvanized steel strip core with extruded liquid-tight polyvinyl jacket. Use O-Z/Gedney Type UAG, or equal.

1. Liquid-tight fittings. ANSI/NEMA FB 1.
2. Connectors: Cadmium plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integral cast external ground lug, O-Z/Gedney.

2.3 NONMETALLIC CONDUIT AND DUCTS

A. Rigid Nonmetallic Conduit: Polyvinyl chloride (PVC) heavy-wall conduit, with tapered sleeve couplings, rated and labeled for use with 90°C rated conductors, manufactured in accordance with ANSI C33.91.

1. Cemented type fittings of the same manufacturer as the conduit.
2. NEMA TC 2 and UL 651, Schedule 40.

B. PVC Conduit and Tubing Fittings

1. NEMA TC 3. Match to conduit or conduit/tubing type and material.

C. Underground PVC and ABS Plastic Utilities Duct

1. NEMA TC-6, Type I for encased burial in concrete, Type II for direct burial.

D. PVC and ABS Plastic Utilities Duct Fittings

1. NEMA TC 9-1. Match to duct type and material.

E. Liquidtight Flexible Nonmetallic Conduit and Fittings

1. UL 1660. Fittings shall be specifically approved for use with this raceway.

F. Conduit, Tubing, and Duct Accessories

1. Types, sizes, and materials complying with manufacturer's published product information. Mate and match accessories with raceway.

2.4 CONDUIT BODIES

A. General

1. Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing

1. Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

2.5 WIREWAYS AND AUXILIARY GUTTERS

- A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select for fulfill wiring requirements comply with applicable provisions of NEC.
- B. Wireways covers shall be hinged type.
 - 1. Use sheet steel wireways with screw-on covers and corrosion resistant hardware. For dry locations coat with rust inhibitor and finish with gray baked enamel. For wet locations use hot-dipped galvanized material finished with gray baked enamel, provide gaskets for covers.

2.6 SURFACE RACEWAY

- A. General
 - 1. Sizes and channels as indicated. Provide fittings that match and mate with raceway.
- B. Surface Metal Raceway
 - 1. Construct of galvanized steel with snap-on covers, with 1/8-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application required. Provided by Hoffman Engineering Co., The Wiremold Co., or approved equal.
- C. Surface Nonmetallic Raceway
 - 1. Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color. Raceway and system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics. Provided by Hubbell, Inc., Panduit Corp., The Wiremold Co., or approved equal.

2.7 ACCESSORIES

- A. General: Reducers, bushings, washers, etc., shall be cadmium plated malleable iron of the shape and dimension best suited for the application.
- B. Seals for Walls and Floor Penetrations: Malleable iron body, oversize sleeve, sealing ring, pressure clamp and rings and sealing grommet, hex head cap screws, O-Z/Gedney Type FSK, or equal.
- C. Fire Seals: Heat activated intumescent material, elastomeric sealing ring,

socket head cap screws, steel pressure discs and flange, O-Z/Gedney Type CFSF, Nelson Flame Seal, or equal.

- D. End bells: Hot-dipped galvanized, threaded malleable iron, O-Z/Gedney Type THS, or equal.
- E. Bushings:
 - 1. 1-1/4" and smaller: High-impact thermo-setting phenolic, 150°C, O-Z/Gedney Type "A", or equal.
 - 2. 1-1/2" and larger: Hot-dipped galvanized with thermosetting phenolic insulation, 150°C, O-Z/Gedney Type "B", or equal.
- F. Locknuts:
 - 1. 1-1/2" and smaller: Zinc plated heavy stock steel, O-Z/Gedney, or equal.
 - 2. 2" and larger: Cadmium plated malleable iron, O-Z/Gedney, or equal.
- G. Hubs: Cadmium plated malleable iron, tapered threads, neoprene "O" ring, insulated throat, O-Z/Gedney, or equal.
- H. Expansion Fittings: Hot-dipped galvanized malleable iron with bonding jumpers.
 - 1. Linear: O-Z/Gedney Type AX and TX, or equal.
 - 2. Linear, with deflection: O-Z/Gedney Type AXDX, or equal.
- I. Escutcheons: Chrome plated sectional floor and ceiling plates, Crane No. 10, or equal.

PART 3 - EXECUTION

3.1 WIRING METHOD

- A. General: The wiring method shall be as follows, except as otherwise noted.
- B. Exterior:
 - 1. Exposed: Rigid steel conduit.
 - 2. Concealed: Rigid steel conduit.
 - a. In or under slab on grade: Nonmetallic conduit, Schedule 40 PVC. Conduit leaving the slab (including exposed conduit riser) shall be rigid steel conduit.
 - 3. Underground, single run: Rigid nonmetallic conduit. Use Schedule 40 PVC. Provide concrete encasement as indicated.
 - 4. Underground, grouped: Rigid nonmetallic conduit. Use Schedule 40 PVC. Provide concrete encasement as indicated.
 - 5. Connection to vibrating equipment, including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: Liquidtight

flexible metal conduit, maximum length 18 inches.

C. Interior:

1. Exposed: Electrical metallic tubing.
 - a. Areas where exposed conduit may be subject to physical damage: Rigid metal conduit.
 - b. Damp or wet locations: Rigid metal conduit.
 - c. Classified locations: Rigid metal conduit.
2. Concealed: Electrical metallic tubing.
 - a. In or under slab on grade: Nonmetallic conduit, Schedule 40 PVC. Conduit leaving the slab (including exposed conduit riser) shall be rigid steel conduit.
 - b. In slab, above grade: Rigid nonmetallic conduit Schedule 40 PVC. Maximum size conduit in slab: 1 inch.
3. Connection to vibrating equipment, including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: Flexible metal conduit, maximum length 18 inches.
 - a. For moist or humid locations or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: Liquidtight flexible metal conduit.
4. Connection to lighting fixtures located in suspended acoustical or metal ceilings: Flexible metal conduit, maximum length 72 inches.
5. Final connections to lighting fixtures which have isolated junction boxes: Flexible metal conduit.
 - a. Damp locations: Liquidtight flexible conduit.

3.2 INSTALLATION

A. General Requirements:

1. Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of NEC, and as follows.
 - a. Minimum size: 3/4 inch unless otherwise indicated.
 - b. Size conduits as indicated on the drawings and as required by the NEC for the number and sizes of wires to be installed into the conduit.
 - c. Make conduit field cuts square with saw and ream out to full size. Shoulder conduits in couplings. Remove burrs, and swab inside conduits before conductors are pulled in.
 - d. Make all conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in a manner to avoid creating

- moisture traps.
- e. Install minimum 3/16" polypropylene pull cords from end-to-end in all empty raceways, tagged with the identification of service intended and location of opposite end. Leave at least 24 inches of pull cord at each end.
 - f. Restore wall, ceiling, and floor penetrations to the requirements of the Authority Having Jurisdiction.
 - g. Provide supports for raceways as specified in Section 260529, Supporting Devices.
 - 1) All raceway shall be supported and braced per SMACNA "Guidelines for Seismic Restraint Systems and Plumbing Piping Systems." (See Footnotes 12 and 13 of Table 23-P of Title 24 for limitations.)
 - h. Communications/Signal System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways 2-inch and smaller trade size in maximum lengths at 150 feet and with a maximum of two, 90-degree bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
 - i. Provide code sized green grounding conductor in all non-metallic conduit.
2. Perform excavating, trenching, backfillings, and compacting as shown, and as specified in the section in Division 2 which prescribes excavation, backfilling and compacting for utilities. Minimum cover for runs below finished grade outside buildings: 24 inches except where noted.
 3. Complete installation of electrical raceways before starting installation of conductors within raceways.
 - a. Protect inside of conduit from dirt and rubbish during construction by capping all openings with plastic caps intended for the purpose. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.
 4. Install all conduits at elevations and locations to avoid interference with grading or other work, the structure, finished ceilings, walls. Avoid causing cutting of masonry structural members.
 - a. Do not place conduits in close proximity to equipment, systems, and service lines, such as hot water supply and return lines, which could be detrimental to the conduit and its contents. Maintain a minimum 3" separation, except in crossing, which shall be a minimum 1".
 - 1) Minimum separation from uninsulated hot water pipes, steam pipes, heater flues or vents: 6 inches. Avoid running conduit directly under water lines.
 - 2) Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
 5. Conceal conduit, unless indicated otherwise, within finished walls,

ceilings, and floors. Keep raceways at least six (6) inches away from parallel runs of flues and steam or hot water pipes. Install raceway level and square and at proper evaluations.

- a. To prevent displacement, securely support and hold in place all conduits installed in advance of other work and to be concealed in the building structure. Carefully lay out conduits run within the structure, such as floors, beams, walls, to avoid densities excessive for the construction. Relocate those conduits when excessive densities occur.
 - b. Run conduits embedded in structural slabs in the middle of the slab below the top and above the bottom reinforcing steel. Minimum cover for conduit in concrete floors, walls or roof: 1/3 thickness of slab, but in no case less than 1-1/2" cover except where penetration is made. Do not install conduit larger than 1" in slabs. Tie raceways to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in the concrete. Where nonmetallic conduit is used, raceways must be converted to Schedule 80 or rigid steel conduit before rising above the floor.
 - c. Where conduit installed in concrete or masonry extends across building construction joints, provide expansion fittings as manufactured by O.Z.; Crouse-Hinds; Appleton; or equal, with approved ground straps and clamps. Expansion fittings installed in concrete shall be water tight - concrete tight deflection/expansion type.
 - d. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated. This does not apply to conduits in crawl spaces.
6. Install and neatly rack exposed conduits parallel with and perpendicular to building walls. Do not install exposed diagonal conduit runs.
- a. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.
 - b. Use blockouts for concentrations of conduits in a confined area.
 - c. Route and suspend conduits crossing expansion joints to permit expansion, contraction, and deflection utilizing approved fittings to prevent damage to the building, conduits, and supporting devices.
 - d. Install exposed raceways parallel and perpendicular to nearby surfaces of structural members and follow the surface contours as much as practical.
 - e. Provide conduit bodies for exposed conduit runs at junctions, bends or offsets where required. Do not use elbows or bends around outside corners of beams, walls or equipment. Make conduit body

covers accessible.

7. Concrete Wall or Stab Penetrations: All core drilling, sleeves, blockouts or other penetrations must be approved by the Structural Engineer prior to installation.
 - a. Space sleeves and core drills to insure a minimum dimension of 3 times the nominal trade diameter of the largest adjacent conduit between sleeves or core drills.
 - b. Use blockouts for concentrations of conduits in a confined area.
8. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.
9. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
 - a. Make no bends with a radius less than 12 times the diameter of the cable it contains nor more than 90 degrees. Make field bends with tools designed for conduit bending. Heating of metallic conduit to facilitate bending is not permitted.
 - b. Bends and offsets in 1" and smaller conduits may be done with approved bending devices. Do not install conduits which have had their walls crushed and deformed and their surface finish damaged due to bending.
 - c. Run conduits parallel to and at right angles to building lines.
 - d. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best required for application.
10. Surface Raceway:
 - a. Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle of fixture ground terminals.
 - b. Select each surface raceway outlet box to which a lighting fixture is attached to be of sufficient diameter to provide a seat for the fixture canopy.
 - c. Where a surface raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy, with or without extension ring, the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.
 - d. Provide surface raceway outlet box, in addition to the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end stem suspension.

- e. Where a surface raceway extension is made from an existing outlet box on which a lighting fixture is installed, provide a backplate slightly smaller than the fixture canopy, and no additional surface mounted outlet box need be installed.
 - f. Surface raceways shall be securely fastened to the mounting surface. Use expansion type anchors in concrete.
11. Do not run conduits exposed on the roof unless approval is obtained from the Owner prior to installation.

B. Other Requirements:

- 1. Connect motors, equipment containing motors, equipment mounted on an isolated foundation, transformers, and other equipment and devices which are subject to vibration and which require adjustment with flexible metallic conduit from the device to the conduit serving it. Size the flexible conduit length more than 12 diameters, but less than 18 diameters. Rigidly support the points of attachment on each side of the connection. Use external bonding jumpers on sizes 1-1/2" and above.
- 2. Install escutcheons on all exposed conduits passing through interior floors, walls, or ceilings. Install fire seals on all conduits passing through fire rated partitions. Install wall and floor fire seals on all conduits passing through exterior walls and floors, or use standard galvanized steel pipe sleeves; diameters 12" greater than the outside diameter of the sleeved conduit and fill the annular space with mastic or caulk with lead.
- 3. Fire pump room: All wiring shall be installed in rigid metal, liquid-tight flexible metal conduit.
- 4. Raceway for panelboards:
 - a. All homeruns shown shall be run to the panel indicated independently of all other homeruns. Provide pull points so as not to exceed total bends of 270 degrees.
 - b. Run a minimum of one 3/4-inch empty conduit for every three single pole spare circuit breakers, spaces or fraction thereof and not less than two 3/4-inch conduits from every flush mounted panel to an accessible space above the ceiling and below the floor.
- 5. Make conduit projections from covered areas to areas exposed to the weather watertight by proper flashing. Extend flashing a minimum of 6 inches in all directions from conduit.
- 6. Cap conduits indicated to be stubbed-out underground using glued on PVC caps intended for this purpose.
- 7. Install a coupling flush with the floor on all conduits stubbed-up through the floor slab.
- 8. Do not penetrate walls with flexible conduit where subject to physical damage. Use recessed box with extension ring for transition from interior to exterior of wall.
- 9. Terminations:
 - a. Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished

- part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
- b. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
 - c. At switchboards, manholes and floor standing distribution panelboards, provide insulated throat bushings or bell ends on all non-metallic conduit entries and bushings on all metallic conduit entries.
 - d. Install insulated throat threaded hubs on conduits entering enclosures without threaded hubs.
 - e. Install end bells on conduits stubbed through slabs and foundations into electrical enclosures.
10. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL- 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 at the following points and elsewhere as indicated:
- a. Where conduits enter or leave hazardous locations.
 - b. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - c. Where required by the NEC.
11. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used six (6) inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.
- a. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so that curved portion of bends is not visible above the finished slab.
12. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet locations. Install separate ground conductor across flexible connections.
13. PVC Coated Rigid Steel Conduit:
- a. Do not store conduit in direct sunlight.
 - b. Use pipe straps, no pipe wrenches or channel wrenches, when

- c. tightening connections to avoid damaging PVC coating.
 - c. Patch all gouges or cuts in the PVC coating after installing conduit. Use manufacturer's recommended patching paste. Build up area to be patched to full mil thickness of coating and feather out paste on sides of damaged area a minimum of 1/2-inch to provide a completely bonded seal.
 - d. Field bend conduit with shoes for a mechanical bender sized for the next larger size conduit.
 - e. Bends used in or below concrete slabs shall be, rigid steel type elbows, use for all stub-ups with flush floor coupling at transitions.
14. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Examine surfaces to which conduits are to be secured for:
 - 1. Defects which will adversely affect the execution and quality of work.
 - 2. Deviations from allowable tolerances for the building material.
- B. Do not start work until defects and deviations are corrected.

3.4 CLEANING

- A. Upon completion of installations of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

3.5 PROTECTION OF FINISHED WORK

- A. Protect inside of conduit from dirt and rubbish during construction by capping all openings with plastic caps intended for the purpose.
- B. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

END OF SECTION 260533

**SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Equipment labels and signs.
 - 2. Identification labeling for raceways, cables, and conductors.
 - 3. Buried electrical line warnings.
 - 4. Warning and caution signs
 - 5. Operational instruction signs.
- B. Electrical identification requirements in this Section may be supplemented in other sections of these specifications.
- C. Related Sections:
 - 1. General electrical requirements: Section 260501.
 - a. Painting: Section 09900.
 - 2. Color coding of conductors for phase identification: Section 2605019.
 - 3. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:
 - 1. ANSI American National Standards Institute.
 - 2. ASTM American Society for Testing and Materials.
 - 3. IEEE Institute of Electrical and Electronics Engineers.
 - 4. NEC National Electrical Code (NFPA 70).
 - 5. NEMA National Electrical Manufacturers Association.
 - 6. NFPA National Fire Protection Association
 - 7. UL Underwriters Laboratories, Inc.

1.3 SUBMITTALS

- A. In addition to this Section, the submittal requirements of Section 260501, "General Electrical Requirements" are applicable.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual labeling and identification of electrical equipment, components, and wiring.

1.6 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.8 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following:

1. Brady
2. Ideal Industries
3. Markal
4. Panduit
5. Thomas & Betts

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Adhesive Marking Labels for Raceway and Metal-clad Cable: Pre- printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Power, Lighting, Air Conditioning, Voice and Data Communications, Control, Fire Alarm and Detection, Public Address (Paging), Electronic Security).
- B. Label Size, as follows:
 1. Raceways 1-Inch and Smaller: 1-1/8 inches high by 4 inches long.
 2. Raceways Larger than 1-Inch: 1-1/8 inches high by 8 inches long.
- C. Color: Black legend on orange background.
- D. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- E. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pre- tensioned gripping action when coiled around the raceway or cable.
- F. Underground Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.
- G. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self- adhesive, wraparound, cable/conductor markers with Preprinted numbers and letter.
- H. Aluminum, Wraparound, Cable Marker Bands: Bands cut from 0.014- inch thick, aluminum sheet, fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.

- I. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with eyelet for fastener.
- J. Aluminum-Faced Card Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inches thick, and laminated with moisture-resistant acrylic adhesive. Pre-print legend to suit the application, and punch for tie fastener.
- K. Brass or Aluminum Tags: Metal tags with tamped legend, punched for fastener. Dimensions: 2 inches by 2 inches by 19 gauge.
- L. Engraved, plastic-laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letter on black face and punched for mechanical fasteners.
- M. Warning and caution signs for indoor use: Shall be minimum 18 gauge steel, white porcelain enamel finish, with red lettering, punched for fasteners, with colors, legend, and size appropriate to the location. Lettering to read, "DANGER - HIGH VOLTAGE - KEEP OUT," unless otherwise indicated.
- N. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gauge, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.
- O. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- P. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
2. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
3. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

- B. Identify electrical equipment and enclosures, including but not limited to the following:
1. General
 - a. Switchgear and switchboards
 - b. Panelboards
 - c. Enclosed switches
 - d. Transfer switches
 - e. Enclosed motor controllers
 - f. Control devices, such as pushbutton- or rotary-selection stations
 - g. Motor control centers
 - h. Substations and transformers
 - i. Contactors
 - j. Lighting system relay cabinets
 - k. Dimming controls
 - l. Power supplies, inverters, and rectifiers
 - m. Pull-, junction-, and splice-boxes
 - n. Terminal boxes and cabinets
 - o. Access doors and panels for concealed electrical items
- C. Identify underground electrical lines:
- D. Identify electrical circuits:
- E. Identify conduit containing circuit wiring operating at over 600 volts:
1. State "DANGER - HIGH VOLTAGE" in black letters 2-inches high, stenciled at 10-foot intervals over a continuous-painted orange background.
 2. In addition, the following areas shall be identified:
 - a. The entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above an unexcavated space.
 - b. On wall surfaces directly external to conduits run concealed within wall.
 - c. On all accessible surfaces of concrete envelope around conduits in vertical shafts, exposed at ceilings, or concealed above suspended ceilings.
 - d. On entire surface of exposed conduits.
- F. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuit. Use pressure-sensitive plastic labels at exposed location and similar labels or plasticized card stock tags at concealed boxes.
- G. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple line installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

- H. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductor throughout the project secondary electrical system as follows:

<u>208/120 Volts</u>	<u>Phase</u>	<u>480/277 Volts</u>
Black	A	Yellow
Red	B	Brown
Blue	C	Orange
White	Neutral	Gray
Green	Ground	Green

- I. Use conductors with color factory-applied the entire length of the conductors except as follow:
1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two lap of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and paced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
- J. Power Circuit Identification: Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuit in vault, pull boxes, junction boxes, manhole, and switchboard rooms with 1/4-inch steel letter and number tamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb test monofilament line or one-piece self-locking nylon cable ties.
- K. Tag or label conductors as follows:
1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
 2. Multiple Circuits: Where multiple branch circuits or control wiring or communications / signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home run) label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and communication / signal wiring, use color coding or wire / cable marking tape at termination and at intermediate location where conductors appear in wiring boxes, troughs, and control cabinet. Use consistent letter / number conductor designation throughout on wire / cable marking tape.
 3. Match identification markings with designations used in panelboards, shop

drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installation.

- L. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instruction or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 - a. In addition to the above:
 - 1) Warning signs shall be included on door, or immediately above door, of all electrical equipment rooms, or closets containing equipment energized above 150 volts to ground.
 - 2) Warning designations in 1-inch high red letters shall be painted by stencil, or applied with pre-printed adhesive labels, on each pullbox, cabinet, or 10-foot length of exposed raceway stating: "DANGER-KEEP OUT," and stating the voltage of the enclosed conductors (for example, "480 VOLTS"), for all systems of over 150 volts to ground.
 2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instruction on power transfer, load shedding, or other emergency operations.
 3. Permanently mount signs with cadmium plated steel screws or nickel-plated brass bolts.
- M. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate (fastened with self-tapping or threaded screws) on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with a minimum of 1/4-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Adhesive letters are not acceptable. Text shall match terminology and numbering shown, if provided. For emergency systems, the background field shall be red and include the word, "EMERGENCY." Apply label for each unit of the following categories of electrical equipment:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - 1) State rating, including voltage, continuous current, horsepower or maximum current switching.
 - 2) For enclosed circuit breakers, state voltage, continuous current,

SECTION 262413 SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes:

1. Distribution switchboards, front-accessible, indoor-type, rated 600 volts and below.

B. Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General- and Supplementary-Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. American National Standards Institute
 - a. ANSI C12 Code for Electricity Metering
 - b. ANSI C39.1 Electrical Analog Indicating Instruments
 - c. ANSI C57.13 Requirements for Instrument Transformers
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. NEC National Electrical Code (NFPA 70)
5. NECA National Electrical Contractors Association "Standard of Installation"
6. National Electrical Manufacturers Association
 - a. NEMA AB 1 Molded Case Circuit Breakers
 - b. NEMA KS 1 Enclosed and Miscellaneous Equipment Switches (600 Volts Maximum)
 - c. NEMA PB 2 Dead Front Distribution Switchboards
 - d. NEMA PB 2.1 General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less
 - e. NEMA 260 Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas

7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.
 - a. UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
 - b. UL 486B Wire Connectors for Use with Aluminum Conductors
 - c. UL 891 Deadfront Electrical Switchboards

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Shop Drawings: Include layouts showing cabinet dimensions, conduit entrances, electrical ratings, bussing connections, single line diagrams, device locations and ratings, and cable termination provisions.
- C. Product Data: Submit for each type of product specified.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260501.
- E. Samples: Provide samples upon specific request.
- F. Certificates:
 1. Labels of UL listing, fixed to each item of material.
 - a. Label of UL listing for service entrance use, where applicable, affixed to material.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA

"Standard of Installation."

- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

1.7 EXTRA MATERIALS

- A. Furnish 3 of each type and size of fuse installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Siemens
- B. General Electric
- C. Square D
- D. Cutler-Hammer

2.2 MATERIALS

- A. Main Switchboard:
 - 1. Furnish and install a totally enclosed, dead front, safety type switchboard designed for voltage and service ampacity as indicated on drawings and mounted on 6" thick concrete pad.
- B. Provide a switchboard consisting of the required number of vertical sections bolted together to form one metal enclosed, rigid switchboard with the following features:

1. The sides, top and rear covered with removable screw-on code gauge steel plates.
 2. Include all protective devices and equipment as listed on drawings with necessary interconnections.
 3. Silver or tin plated copper bus.
 4. Bus bars mounted on supports of high impact nontracking insulation material braced to withstand mechanical forces exerted during 100,000 amp RMS symmetrical short circuit conditions, or as required by serving utility.
- C. Chemically clean steel surfaces and treat to aid bonding between paint and metal surfaces. Provide high tensile strength hardware on conductors and suitable protective finish.
- D. Provide full length copper ground bus. Secure a ground bus to each vertical section of structures and extend it the entire length of the switchboard.
- E. Provide switchboard with adequate lifting means, capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.
- F. Use A-B-C type bus arrangement - left-to-right, top-to-bottom and front-to-rear throughout. Switchboard shall be entirely accessible from the front, including cable and bus connections, unless specifically noted otherwise.
- G. Provide group mounted, quick-break protective devices with bar connection straps, with device line and load connections accessible from the front. Where "spaces" are scheduled furnish entire bus except device connecting straps. Provide full height wiring gutter covers for quick access to wiring terminals.
- H. The switchboard frame work shall be made of formed steel angles securely bolted or riveted together. Adjacent to each switch unit provide a lamacoid plastic name plate engraved with proper circuit designation, screw-on type only.
- I. At top of switchboard and supported on the frame, there shall be provided a pull box for termination of the conduits to the board. It shall not be less than 18" in height and shall be built as an integral part of the switchboard. The front of the pull box shall be removable and the bottom shall consist of ebonized asbestos panels drilled for cables and bussing. The entire exterior of the switchboard and pull box enclosures shall be painted with prime coat and finished smooth with 2 coats of gray enamel, ASA 33.
- J. Switches over 600 ampere capacity shall be bolted pressure contact type of capacity and number of poles indicated and equipped with Bussmann Hi-Cap, current limiting fuses only.
- K. Switches 600 ampere and below shall be quick-make, quick-break of capacity and number of poles indicated.
- L. Switches 600 amperes and below shall be equipped with rejection type fuse clips to accept only high capacity type fuses. Furnish current limiting type fuses.

- M. Main busses shall be silver or tin plated copper sized on the basis of a current density to hold temperature rise to 50 degrees C above 40 degrees C ambient. The bus structure shall be braced to withstand the mechanical forces exerted during a fault as shown on the drawings.
- N. The switchboard shall bear the label of approval of the Underwriter's Laboratories and shall be built to NEMA and IEEE standards. Seven copies of shop drawings of the proposed board shall be furnished to comply with these specifications.
- O. Circuit breakers:
1. Resettable, quick-make, quick-break, bolt-in place type, trip-free, with separate trip position from on and of positions.
 2. Multiple pole breakers with common trip and one operation handle.
 3. Do not provide handle ties.
 4. Wire with sequence phasing.
- P. Furnish record drawings providing the following information;
1. Complete rating.
 2. Short circuit withstand-ability of bus and Lowest rated device.
 3. Overall outline dimensions including space available for conduits.
 4. Circuit schedule showing circuit number
 5. Device description
 6. Feeder circuit identification
 7. Conductor ratings and one-line diagram with each circuit device numbered.
- Q. Provide switchboards meeting U.L. Standard #UL891 and NEMA Standard PB-2. The U.L. label shall appear on all switchboard sections which contain U.L. listed devices.
- R. Provide ground fault protection on each main devices, rated 480/277 ground wye, 1000 amps or larger, as follows:
1. U.L. listed ground sensor relay system equal to General Electric GSR. Provide ground break components for each system with coordinated ground sensor (CR) and integral test winding. Provide with solid state relay to operate shunt trip circuit on the switch and monitor panel.
 2. Use time relay with the following features:
 - a. Continuously adjustable current pick-up settings of 100 to 1200 amperes.
 - b. Continuously adjustable time delay setting from instantaneous (.03 seconds) to one second.
 - c. Memory function to recognize and initiate tripping on intermittent ground faults.
 3. Install panel which:

- a. Indicates relay operation.
 - b. Provides means for testing the system with or without interruption of electrical service.
 - c. Does not permit the ground fault system to be inadvertently left in an inactive or "off" state.
4. Use ground sensor for zero sequence arrangement on the main service entrance devices.
- S. Provisions for padlocking the circuit breakers or disconnect in the "on" and "off" positions.
- T. Provide full rated bussing (no cascading).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Carefully measure and lay out exact locations of switchboards in conference with Owner.
- B. Assure that panelboards may be installed without adversely affecting the integrity and appearance of the building structure and with the clearances required by the National Electrical Code.

3.2 INSTALLATION

- A. Install switchboard sections plumb and in straight horizontal alignment, securely fasten to one another, and anchor to floor slab with adequate concrete inserts and 5/8-inch bolts.
- B. Install distribution switchboards on concrete foundations in accordance with other sections of the specifications.
- C. Terminate service and feeder conduits only in the switchboard section containing the lugs or device to which they are to be connected.
- D. Provide switchboards of the types and ratings scheduled where indicated.
- E. Provide supports to the building structure, independent of raceways.
- F. Install switchboards so that highest disconnecting breaker or switch handle is at a maximum of 6 feet 6 inches above finished floor.
- G. Provide identification:
 - 1. For switchboard circuits: Engraved, lamacoid plastic nameplate, white with black letters, giving circuit numbers and equipment identification.
 - 2. All nameplates to be stainless steel screw-on types, no cement.

- H. The anchorage of motor and circuit disconnects required for elevator drives, emergency generator, emergency motor loads, fire pumps and emergency lighting shall be designed in accordance with Section 2312 of the Uniform Building Code for a lateral force based on a "Cp" value.

3.3 FIELD QUALITY CONTROL

- A. Perform manufacturer's recommended field test prior to energization.
- B. Provide copies of test results to Owner.

3.4 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates on all switchboards not shown as exiting on the single line diagram, unless otherwise noted.
- B. Provide equipment and circuit designation on nameplates with minimum letter and plate sizes as indicated.
- C. Provide engraved plastic nameplates with 1/4-inch minimum height letters indicating circuit designation at branch overcurrent devices in switchboards.
- D. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

END OF SECTION 262413

**SECTION 262416
PANELBOARDS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes:

1. Branch circuit and distribution panelboards, both circuit breaker- and fused switch-type, rated 600 volts and below.

B. Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General- and Supplementary-Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. NEC National Electrical Code (NFPA 70)
5. NECA National Electrical Contractors Association "Standard of Installation"
6. National Electrical Manufacturers Association
 - a. NEMA AB 1 Molded Case Circuit Breakers
 - b. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies
 - c. NEMA PB 1 Panelboards
 - d. NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.
 - a. UL 50 Cabinets and Boxes
 - b. UL 67 Panelboards

1.3 SUBMITTALS

A. General: Submit the following in accordance with the General- and Supplementary

Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."

- B. Shop Drawings: Include layouts showing cabinet dimensions, conduit entrances, electrical ratings, bussing connections, single line diagrams, device locations and ratings, and cable termination provisions.
- C. Product Data: Submit for each type of product specified.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
 - 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260501.
- E. Samples: Provide samples upon specific request.
- F. Certificates:
 - 1. Labels of UL listing, fixed to each item of material.
 - a. Label of UL listing for service entrance use, where applicable, affixed to material.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a

manner to prevent damage from the elements, personnel, equipment, and moisture.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Siemens
- B. General Electric
- C. Square D
- D. Cutler-Hammer

2.2 MATERIALS

- A. Branch circuit panelboards:
 - 1. Provide factory assembled, enclosed panelboards in dead front cabinets, with doors, surfaced mounted or recessed as indicated, not less than 20" wide and 5-3/4" deep. Height will depend on the number of breakers and spaces.
 - 2. Where a control compartment is indicated, provide an integral compartment with a separate hinged lockable door held with captive screws.
 - 3. Provide feeder terminal lugs for both main lugs only and main breakers rated for use with copper or aluminum conductors.
 - 4. Provide three phase, 4 wire, solid neutral design with sequence bussing, full capacity neutral and full length copper bussing including areas indicated as space only. Bussing shall be braced for maximum available fault.
 - 5. Provide copper neutral bus where neutral bus is indicated. Neutral bus shall be sized for minimum twice the current carrying capacity of line bus.
 - 6. Key all door locks alike. Provide a type written directory of circuit index card holder mounted behind the door in framed card slot with plastic see through window.
 - 7. Provide full size copper equipment ground bus.
 - 8. All breakers shall be bolt-on type molded case. No tie handle is accepted for multi-pole breaker.
 - 9. Provide pad lock off devices on all breakers serving appliances, motor operated equipment, HVAC equipment and other circuit as indicated on panel schedules.
 - 10. 120/208V, 3 Phase, 4 Wire Panelboards: General Electric Co. type NLAB, Square D Co. type NQOB, or Cutler-Hammer type POW-R-LINE1.
 - 11. 277/480V, 3 Phase, 4 Wire Panelboards: General Electric Co. type NHB, Square D Co. type NEHB, ITE, Inc. type NHB, Sylvania Co. type NH1B or

- Cutler-Hammer type POW-R-LINE2.
12. All equipment shall be listed to meet or exceed the available fault current indicated on drawings.
 13. Provide main lugs only unless scheduled otherwise.
 14. Construct in accordance with U.L. and NEMA Standards.

B. Distribution Panelboards:

1. Provide circuit breaker type distribution panelboards with fully rated copper bus, lockable molded case breakers for mains and feeders. Provide nameplates for all circuit breakers.
2. Busing shall be braced to withstand maximum available fault current indicated on drawings.
3. Provide copper neutral bus where indicated. Neutral bus shall be sized for minimum twice the current carrying capacity of line bus.
4. Provide full size copper ground bus adequate for number of grounded circuits.
5. General Electric Co. type NCP and type CCB, or Square D Co. types HCN and HCM, or Cutler-Hammer type POW-R-LINE3 and POW-R-LINE4B.

C. Circuit breakers:

1. Resettable, quick-make, quick-break, bolt-in place type, trip-free, with separate trip position from on and off positions.
2. Multiple pole breakers with common trip and one operation handle.
3. Do not provide handle ties.
4. Wire with sequence phasing.
5. Circuit breakers shall be rated to meet or exceed the available fault current indicated on drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Carefully measure and lay out exact locations of panelboards in conference with Owner.
- B. Assure that panelboards may be installed without adversely affecting the integrity and appearance of the building structure and with the clearances required by the National Electrical Code.

3.2 INSTALLATION

- A. Provide panelboards of the types and ratings scheduled where indicated.
- B. Provide flush or surface mounted types where indicated and scheduled.
 1. Provide multi-section cabinets as required and scheduled.
 2. Provide 2 keys for each panelboard.

- C. Provide supports to the building structure, independent of raceways.
- D. Install tops of cabinets at 6 feet 6 inches above finished floor.
- E. Install panelboards in cabinets, centered in door openings.
- F. Secure panelboards to building structure to withstand wire pulling strains.
- G. Secure surface mounted panelboards to wood studs or channel material spanning metal studs.
- H. Do not use toggle bolts.
- I. Provide identification:
 - 1. For panelboards: Engraved, lamacoid plastic nameplate, white with black letters, giving panelboard designation, voltage, phase, wire and ampacity.
 - 2. For branch circuit panelboards: Neatly typewritten circuit directory in cardholder inside panelboard door. Identify rooms served using room numbers corresponding to those finally established at the project.
 - 3. All nameplates to be stainless steel screw on types, no cement.

3.3 FIELD QUALITY CONTROL

- A. Perform manufacturer's recommended field test prior to energization.
- B. Provide copies of test results to Owner.

END OF SECTION 262416

**SECTION 262716
ELECTRICAL CABINETS AND ENCLOSURES**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Floor boxes and service fittings.
4. Boxes and fittings for hazardous locations.
5. Cabinets.
6. Hinged door enclosures.

B. Related Sections:

1. General electrical requirements: Section 260501.

C. The following related items are specified in Section 260533 - Raceways: conduit-body-type electrical enclosures and wiring fittings, wireways, and auxiliary gutters.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute.
2. American Society for Testing and Materials.
 - a. ASTM 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
 - b. ASTM 167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
3. IEEE Institute of Electrical and Electronics Engineers.
4. NEC National Electrical Code (NFPA 70).
5. National Electrical Manufacturers Association.
 - a. NEMA 250 Enclosures for Electrical Equipment (1000 Volts

- b. NEMA ICS6 Maximum).
 - c. NEMA OS1 Enclosures for Industrial Controls and Systems.
 - d. NEMA OS2 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
 - e. NEMA OS2 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
6. NFPA National Fire Protection Association
7. Underwriters Laboratories, Inc.
- a. UL 50 Electrical Cabinets and Boxes.
 - b. UL 514A Electrical Metallic Outlet Boxes.
 - c. UL 514B Fittings for Conduit and Outlet Boxes.
 - d. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
 - e. UL 886 Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 SUBMITTALS

- A. In addition to this Section, the submittal requirements of Section 260501, "General Electrical Requirements" are applicable.
- B. Product data: Boxes, cabinets, and fittings.
- C. Shop drawings: Provide for boxes, cabinets, and enclosures that are to be shop fabricated (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions and finishes. For cabinets and hinged enclosures, drawings shall include dimensions, knockout sizes and locations, material types and gauges, finishes, and installation method.
- D. Certificates shall include labels of Underwriters' Laboratories, Inc., and National Electrical Manufacturer's Association affixed to each item.
- E. Record actual locations and mounting heights of outlet-, pull-, and junction-boxes, and cabinets and hinged door enclosures, on project record documents.

1.4 DEFINITIONS

- A. Cabinet: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.
- B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.
- C. Enclosure: A box, case, or cabinet, or housing for electrical wiring or components.

- D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.
- E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.
- F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

1.5 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.7 PROJECT CONDITIONS AND SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify locations of boxes, cabinets, and enclosures prior to rough-in.
- C. Placement shown on Drawings in approximate locations unless dimensioned. Install as required to complete wiring system.

1.8 SEQUENCING

- A. Install boxes, cabinets, and enclosures in coordination with other work, and at times required to prevent delays in the work and to avoid cutting of masonry units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with requirements, provide products by the following, or equal:

A. General:

1. Appleton Electric Company
2. Hubbell
3. Steel City
4. O.Z./Gedney
5. Hoffman
6. Circle AW

B. Boxes and fittings for hazardous locations:

1. Crouse Hinds
2. Killark Electric Mfg.
3. Robroy Industries
4. Spring City Electrical Mfg.
5. Woodhead Industries

C. Floor Boxes:

1. Hubbell
2. Raco
3. Thomas & Betts
4. Walker
5. Wiremold

D. Cabinets:

1. Circle AW
2. Hoffman Engineering
3. Spring City Electrical Mfg.

2.2 GENERAL

Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the

intended use. Provide gaskets for units in damp or wet locations.

A. Materials and Finishes:

1. Sheet steel: Flat-rolled, code-gauge, galvanized steel.
2. Fasteners for general use: Corrosion-resistant screws and hardware, including cadmium and zinc-plated items.
3. Fasteners for wet or damp locations: Stainless steel screws and hardware.
4. Cast metal for boxes, enclosures and covers: Copper-free aluminum except as otherwise indicated.
5. Exterior finish: Gray-baked enamel for items exposed in finished locations except as otherwise indicated.
6. Painted interior finish: Where indicated, white baked enamel.
7. Fittings for boxes, cabinets, and enclosures: Conform to UL 514B. Malleable iron or zinc-plated steel for conduit hubs, bushings and box connectors.

2.3 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

- A. General: Conform to UL 514A and UL 514B. Boxes shall be of type, shape, size, and depth to suit each location and application.
- B. Steel Boxes: NEMA OS 1. Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.
- C. Cast Aluminum Boxes: Copper-free aluminum with gasketed covers, threaded raceway entries, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices and closure plugs.
- D. Cast Iron Boxes: Iron alloy, waterproof, with gasketed covers and threaded raceway entries, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices and closure plugs.
- E. Floor Boxes:
 1. Cast Iron Floor Boxes: Fully-adjustable, waterproof, with threaded raceway entrances, adjusting rings, gaskets, and brass floor plates. Where indicated, provide multi-section boxes with individual hinged section covers and provide for a duplex receptacle under one or more of the covers.
 2. Steel Floor Boxes: Sheet steel, concrete tight, fully adjustable, with stamped knockouts, adjusting rings, and brass floor plates. Where indicated, provide multi-section boxes with concealed individual section covers under a common flush floor plate. Provide for a duplex receptacle in one of the concealed section covers and a one inch diameter bushed opening in the other.
 3. Service Fittings for Floor Outlet Boxes: Surface mounted horizontal, cast aluminum type, three inches high, suitable for finished spaces and

finished in stain aluminum, except where otherwise indicated. Provide duplex receptacle or one inch diameter bushed opening for telephone or other communications service as indicated. Equip fitting for attaching flat to floor box cover.

2.4 NONMETALLIC OUTLET, DEVICE, AND SMALL WIRING BOXES

- A. General: Conform to NEMA OS 2, and UL 514B and 514C. Boxes shall be high-impact resistant molded PVC units with covers and integrally-molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting, be equipped with an integral ground lug, and be of the type, shape, size, and depth to suit location and application.
 - 1. Boxes for Concealed Work: Mounting provisions and wiring entrances to suit installation conditions and wiring method used.
 - 2. Boxes for Exposed Work: Ultraviolet-stabilized, non-conductive, high impact-resistant boxes with integrally-molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching PVC material suitable for the application.

2.5 PULL AND JUNCTION BOXES

- A. General: Conform to UL 50, for boxes over 100 cubic inches in volume. Boxes shall have bolted-on covers of material same as box, and shall be of the size and shape to suit the application.
- B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
- C. Hot-Dip Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanize after fabrication. Cover shall be gasketed.
- D. Stainless Steel Boxes: Fabricate of stainless steel conforming to Type 302 of ASTM A 167. Where necessary to provide a rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.
- E. Cast Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.
- F. Cast Nonmetallic Boxes: Ultraviolet stabilized, non-conductive, high impact-resistant PVC boxes with gasketed cover and integral mounting flanges.
- G. Boxes Approved for Classified Locations: UL 886. Cast metal or cast nonmetallic boxes, listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.6 CABINETS

- A. General: Conform to UL 50.
- B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one-piece frame and hinged door. Arrange door to close against a rabbet placed around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.
- C. Doors: Double doors for cabinets wider than 24 inches. Telephone cabinets wider than 48 inches may have sliding or removable doors.
- D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks shall be of a type to permit doors to latch closed without locking.

2.7 STEEL ENCLOSURES WITH HINGED DOORS

- A. General: Conform to UL 50.
- B. Construction: Sheet steel, 16 gauge minimum, with continuous welded seams. NEMA class as indicated, arranged for surface mounting.
- C. Doors: Hinged directly to cabinet and removable, with approximately 3/4 inch flange around all edges, shaped to cover edge of box. Provide handle-operated key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.
- D. Mounting Panel: Provide painted removable internal mounting panel for component installation.
- E. Enclosure: NEMA 12, except as indicated. Where door gasketing is required, provide neoprene gasket attached to oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.8 CAST METAL ENCLOSURES WITH HINGED DOORS

- A. Copper-free aluminum with bolted, hinged doors. Where used at classified locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

2.9 MOLDED NONMETALLIC ENCLOSURES WITH HINGED DOOR

- A. General: Molded, glass fiber reinforced high impact strength polyester with bolt or screw-secured doors and solid neoprene gaskets.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each locations and in conformance with the following requirements, except as otherwise indicated:
 - 1. Interior dry locations: NEMA type 1, [sheet steel] [nonmetallic].
 - a. In dry walls for single and two gang outlets provide 4S and 4D boxes, for 3 or more outlets use masonry boxes.
 - b. In block and masonry walls provide masonry boxes of depths required for wall thickness.
 - c. In poured concrete and plastered walls provide 4S and 4D boxes for single gang outlets and 2G and 3G-5075 boxes for multiple ganged outlets.
 - d. In concrete ceilings provide OCR rings. In other ceilings provide 40 and 40D boxes. Omit covers if standard canopy and device plates entirely cover the ceiling opening.
 - 2. Locations exposed to weather or dampness: [Cast metal] [Molded PVC], NEMA type 3R.
 - 3. Wet locations: NEMA type 4 enclosures.
 - a. In exposed work, exterior of buildings, in wet location, and flush in non-waterproofed walls below grade provide FS and FD boxes.
 - 4. Corrosive locations: NEMA type 4X enclosures.
 - 5. Hazardous (Classified) locations: Cast metal, UL 886, NEMA type listed and labeled for the location and class of hazard indicated.
- B. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types as follows, except as otherwise indicated:
 - 1. Interior dry locations: NEMA type 1, sheet steel.
 - 2. Locations exposed to weather or dampness: NEMA type 3R, sheet steel.
 - 3. Wet locations: NEMA type 4 enclosures.
 - 4. Corrosive locations: NEMA type 4X enclosures.
 - 5. Hazardous (Classified) locations: Cast metal, UL 886, NEMA type listed and labeled for the location and class of hazard indicated.
- C. Floor Boxes: In slabs on grade and wet locations: Use NEMA type 4 boxes. At other locations in slabs, use concrete-tight NEMA 1 boxes.
 - 1. Provide floor boxes with quantity of gangs as required for power,

communication or control as indicated. Use boxes with barriers where required. Provide carpet flanges in carpeted areas.

- D. Hinged Door Enclosures: NEMA type 12, except as indicated.
- E. Hinged Door Enclosures Outdoors: NEMA type 3R, with drip hood, factory tailored to individual units.
- F. Hinged Door Enclosures in Corrosive Locations: NEMA type 4X [metal] [nonmetallic] enclosure.
- G. Cabinets: Flush mounted, NEMA enclosure type 1, except as otherwise indicated.

3.2 INSTALLATION, GENERAL

- A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.
- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs. Provide standard manufactured plugs in unused openings of boxes.
- C. Support and fasten items securely in accordance with Division 26 Section "Supporting Devices."
- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- E. Remove sharp edges where they may come in contact with wiring or personnel.
- F. Do not provide through-the-wall and back-to-back boxes. Provide minimum 24" between outlet boxes on all fire-rated walls.
- G. Provide boxes at the terminal of conduit runs to outlets and devices.
- H. Center outlets in paneling and in other Architectural features.
- I. Locate light fixture outlets in uniform relation with ceiling tiles.
- J. Group outlets on circuits with homeruns as indicated on the drawings.
- K. Provide plaster rings and covers where required by the building structure.

3.3 INSTALLATION OF OUTLET BOXES

- A. Outlets at windows and doors: Locate close to window trim. For outlets indicated above doors, use 6 feet-9 inches mounting height above finished floor and center outlets above the door opening except as otherwise indicated.

- B. Column and pilaster locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- C. Locations in special finish materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Sawcut all recesses for outlet boxes in exposed masonry walls.
1. Provide 1" deep plaster rings on recessed outlet boxes installed in areas where concrete will be exposed after construction is complete.
 2. Where boxes are concealed in exposed concrete unit masonry, use square cornered type boxes, or boxes fitted with rings of sufficient depth for the box to be recessed completely within cavity of block or tile. Install box to insure that ring fits an opening sawed out of the masonry, so that no mortar is required to fill between ring and construction.
- D. Gasketed boxes: At the following locations use cast metal, threaded hub-type boxes with gasketed weatherproof covers:
1. Exterior locations.
 2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations.)
 3. Where exposed to moisture-laden atmosphere.
 4. At food preparation equipment within four feet of steam connections.
 5. Where indicated.
- E. Cast iron boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- F. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.
1. Provide 3/8 inch studs in ceiling- and wall-mounted lighting fixture outlet boxes where shop drawings of fixtures require and elsewhere as may be required for fixtures.
- G. Ceiling outlets: For fixtures, where wiring is concealed, use octagonal outlet boxes, 4 inches by 2 inches deep, minimum.
- H. Cover plates for surface boxes: Use plates sized to box front without overlap.
- I. Protect outlet boxes to prevent entrance of plaster and debris. Thoroughly clean foreign material from boxes before conductors are installed.

- J. Floor boxes: Install in concrete floor slabs so they are completely enveloped in concrete except for the top. Where normal slab thickness will not envelop box as specified above, provide increased thickness of the slab. Provide each compartment of each floor box with grounding terminal consisting of a washer-in-head machine screw, not smaller than No. 10-32, screwed into a tapped hole in the box. Adjust covers of floor boxes flush with finished floor.

3.4 INSTALLATION OF PULL AND JUNCTION BOXES

- A. Pull boxes and junction boxes shall be securely mounted to the building structure.
 - 1. Fastenings shall be made by means of not smaller than 3/16" diameter bolts, expansion bolts, or toggle bolts; not smaller than No. 9" x 1" wood screws; or by equivalent fastenings; where exposed to weather or moisture, shall be galvanized. Do not use nails, or wood or fiber inserts in masonry.
 - 2. On masonry or concrete walls, columns or flooring, fastenings shall be made by means of lead expansion shields not smaller than size 3/8" diameter by 5/8" long for use with No. 10-24 round head machine screws. Machine screws shall be not less than 1-1/4" long for installation on ceiling and not less than 1" long elsewhere.
 - a. Holes for lead expansion shields shall be carefully and accurately drilled, using sharp drills to a depth which will afford the maximum practical engagement of threads (depth equal to screw length not less than 1-1/4" past plaster into solid concrete). Installation shall develop full strength of screw.
- B. Pullboxes for concealed wiring shall be mounted flush in walls, partitions, and ceilings, unless otherwise indicated.
 - 1. Use cast iron boxes flush in slab on grade.
- C. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box.
- D. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
- E. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
- F. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by NEC Article 370, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

- A. Installations shall be secure and substantial; cabinets shall be attached to building walls or structure.
- B. Mount with fronts, trim, and doors straight and plumb.
- C. Install with tops 78 inches above finished floor.
- D. Set cabinets in finished spaces flush with walls.
- E. Identification: Provide identification nameplates on inside and outside of covers and doors on each cabinet and hinged enclosure, engraved bakelite with 1/4 inch minimum height letters, securely fastened with stainless steel screws. Text shall identify the function of the cabinet or enclosure, for example, "Dimming Panel," unless otherwise indicated.

3.6 GROUNDING

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box, or enclosure.

3.7 CLEANING AND FINISH REPAIR

- A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks. Clean surfaces to be painted.
- B. Galvanized finish: Repair damage using a zinc-rich paint recommended by the manufacturer.
- C. Painted finish: Repair damage using matching corrosion-inhibiting touch-up coating.

END OF SECTION 262716

**SECTION 262726
WIRING DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Receptacles.
2. Snap Switches.
3. Incandescent Lamp Dimmer-Switches.
4. Fluorescent Lamp Dimmer-Switches.
5. Wall Plates.
6. Floor Service Outlets.
7. Poke-Through Assemblies.
8. Telephone/Power Poles.

B Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSIAmerican National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. NEC National Electrical Code (NFPA 70)
5. NECA National Electrical Contractors Association: "Standard of Installation"
6. NEMA National Electrical Manufacturers Association
7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.
 - a. UL 20 General Use Snap Switches
 - b. UL 94.3 UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
 - c. UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
 - d. UL 498 Molded-Case Circuit Breakers and Circuit Breaker

- Enclosures
- e. UL 1010 Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
- f. WD 1 General Requirements for Wiring Devices
- g. WD 6 Wiring Device-Dimensional Requirements

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Product Data: Submit for each type of product specified.
- C. Installation instructions: Manufacturer's written installation instructions for wiring devices. Include instructions for storage, handling, protection, examination, and preparation of Product.
- D. Samples: Provide samples under specific request.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following:

1. Crouse-Hinds
2. Hubbell
3. Pass and Seymour
4. Square D
5. Walker

2.2 WIRING DEVICES

- A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color of all device plates with Project Architect or Interior Designer prior to placing order.
- B. Receptacles: UL 498 and NEMA WD 6. Straight blade, two-pole, three-wire grounding type, except as otherwise indicated below:

RECEPTACLES: RATINGS AND TYPES [1]					
OUTLET TYPE	CURRENT RATING	VOLTAGE RATING	NEMA CONFIGURATION	UL GRADE	MANUFACTURER [5]
Duplex	20 A	125 V	5-20R	Heavy Duty	Hubbell 5362
Duplex, GFI [2]	20 A	125 V	5-20R	Heavy Duty w/Integral GFI	Hubbell GF5362
Duplex, Hospital	20 A	125 V	5-20R	Hospital	Hubbell 8300
Single	20 A	125 V	5-20R	Heavy Duty	Hubbell 5361
Single	20 A	250 V	6-20R	Heavy Duty	Hubbell 5461
Single, Locking [3]	20 A	125 V	L5-20R	Heavy Duty	Hubbell 2310
Single, Locking [3]	20 A	250 V	L6-20R	Heavy Duty	Hubbell 2320
Pin and Sleeve [4]	As Required	As Required	Not Applicable	498-General; 1010-Classified Locations	Hubbell

- Notes:
1. Except as otherwise indicated.
 2. GFI receptacles shall protect downstream receptacles on same circuit.
 3. Provide locking receptacles with black nylon face, except as otherwise indicated.
 4. Provide features indicated.
 5. Verify color selection with Architect/Engineer. (As listed, each catalog number specifically indicates the color of the device - revision may be required.)

C. Switches: UL 20 and NEMA WD 1. Quiet toggle-type AC switch. Ratings and types, except as otherwise indicated:

SWITCHES: RATINGS AND TYPES [1]				
TYPE	LOAD RATING	VOLTAGE RATING	UL GRADE	MANUFACTURER [4]
Single Pole	20 A	120/277 V	Heavy Duty	Hubbell HBL 1221
Double Pole	20 A	120/277 V	Heavy Duty	Hubbell HBL 1222
Three Way	20 A	120/277 V	Heavy Duty	Hubbell HBL 1223
Four Way	20 A	120/277 V	Heavy Duty	Hubbell HBL 1224
Single Pole w/Pilot Light [2]	20 A	120/277 V	Heavy Duty	Hubbell HBL 1221-PL7
Single Pole w/Key Switch	20 A	120/277 V	Heavy Duty	Hubbell HBL 1221-L
Momentary Contact Type [3]	20 A	120/277 V	Heavy Duty	Hubbell HBL 1557

- Notes:
1. Except as otherwise indicated.
 2. For switch with pilot light, the light is "ON" when the load is "ON".
 3. For momentary contact type switch, operation is three position - two circuit momentary contact and center off.
 4. Verify color selection with Architect/Engineer. (As listed, each catalog number specifically indicates the color of the device - revision may be required.)

D. Dimmer Switches: Solid-state dimmer switches, mount in outlet boxes as indicated and in accordance with the following:

1. Incandescent Lamp Dimmer: Modular type, 120-volts, 60-Hz, switch poles and wattage as indicated, with continuously-adjustable rotary knob or toggle, anodized aluminum face, with soft-tap or other quiet on-off switch. Equip with electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch minimum wire connecting leads. Derate dimmer switch per manufacturer's recommendations where dimmers are ganged together.
2. Fluorescent Lamp Dimmer: Full-wave modular type AC dimmer for fluorescent fixtures; wattage and voltage ratings as indicated, and electromagnetic filter to eliminate noise, RF and TV interference. Construct with continuously-adjustable trim potentiometer with adjustment of low and dimming, anodized heat sinks, with quiet on-off switch and 5-inch minimum wire connecting leads. To ensure coordination with dimming type ballasts in fixtures, specific dimming device shall be approved for use in writing by the ballast manufacturer.

2.3 WIRING DEVICE ACCESSORIES

- A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which they are attached, and are from the same manufacturer. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Wall plate color shall be as selected by Architect / Engineer. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section 260553, "Electrical Identification."
1. Interior Areas: Smooth, high-impact resistant plastic, of the same manufacturer as the device.
 - a. Voice, data, or video communications system outlets: Same as for wiring devices except with 3/8 inch or 1 inch rubber grommets as required.
 - b. Surface mounted outlet boxes: Zinc coated sheet steel rounded edges, same size as outlet box.
 - c. Kitchen and food preparation areas: Polished stainless steel type, 0.40 inches thick.
 2. Exterior areas: Weatherproof, corrosion-resistant type, die cast aluminum with self-closing gasketed cover. For duplex receptacles, use Hubbell 5206-WO or equal; for wall switches, use Hubbell 7420 or equal; for GFI receptacles, use manufacturer's listed plate.
- B. Floor Service Outlets: Modular, above-floor service outlets and fittings of types and ratings indicated. Construct of die-cast aluminum, satin finish. Use design compatible with floor outlet wiring methods indicated. Provide 20-ampere, 125-volt, gray duplex receptacle. Provide with 3/4 inch or 1-inch NPT, 1-inch long, locking nipple for installation where compatible with wiring method.
- C. Poke-Through Assembly Devices: Factory-fabricated poke-through assembly devices with multi-channeled thru-floor raceway/firestop assembly and below-floor junction box assembly.
1. Above-floor service pedestal: Include service outlets in above-floor four-gang service fitting of die-cast satin-finish aluminum with one 20 ampere, 125 volt, gray NEMA 5-20R duplex receptacle and one duplex modular duplex voice/data communications jack, including separation barrier between line- and low-voltage section. Provide integral assembly UL listed as a total unit, with fire rating consistent with that of floor penetrated. Provide through-floor fitting: Hubbell Type PT7XC, plus a below-floor junction box; and service pedestal: Hubbell Type FR480.
 2. Flush-floor service assembly: Include service outlets in flush-floor brass service fitting with one 20 ampere, 125 volt, NEMA 5-20R duplex receptacle and two openings for up to one 25-pair telephone cable per opening. Provide integral assembly UL listed as a total unit, with fire rating consistent with that of floor penetrated. Receptacle shall be protected when not in use with independent, spring-loaded lift covers.

Provide one-piece through-floor fitting including carpet flange: Hubbell Type PT7FBRS2; and duplex receptacle: Hubbell Series 5352.

- D. Telephone/Power Service Poles: Factory-assembled combination telephone/power poles of types, sizes, and ratings indicated; for use with telephone and power systems installed above suspended ceilings. Construct with provisions for one 50-pair telephone cable, and two-20 ampere, 125 volt, three-wire receptacles. Isolate power section from telephone compartment with separating metal barrier. Extend wiring from receptacles to junction box at top of pole where connections are made above suspended ceiling. Provide ceiling trim plate and pole foot with carpet pad. Where poles are located in accessible ceiling areas, provide bracing arranged for positive connection to ceiling supports. Provide finish treatment and color as selected by the Architect/Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wiring devices and accessories as indicated, in accordance with manufacturers written instructions, applicable requirements of the NEC, and in accordance with recognized industry practices to fulfill project requirements.
 - 1. Mount switches and receptacles in vertical position in building interiors.
 - 2. Mount receptacles with weatherproof plates in horizontal position.
 - 3. Install receptacles mounted vertically so that the ground contact falls on the top position, and horizontally mounted receptacles with neutral pole in top position.
 - 4. Individually Mounted Dimmers: Install in accordance with manufacturer's ventilation clearance requirements.
- B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.
- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt and debris.
- D. Install wiring devices after wiring work is completed.
- E. Install wallplates after painting work is completed.
- F. Install telephone/power service poles - in accordance with final furnishings arrangement - plumb, true, and secure.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturers' torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL

486A. Use properly-scaled torque indicating hand tool.

3.2 INSPECTION

- A. Inspect boxes into which wiring devices are to be installed for defects which affect the quality and execution of work.
- B. Do not start work until defects are corrected.

3.3 PREPARATION

- A. Determine where types of wiring devices are to be installed.
- B. Verify devices are of correct size, capacity, type, and NEMA configuration.

3.4 ADJUSTMENT

- A. Align device and cover plate vertically and horizontally assuring flush fitting.

3.5 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.6 FIELD QUALITY CONTROL

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
- B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION 262726

**SECTION 262801
LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes:

1. Circuit breakers and fuses, rated 600 volts and below.
 - a. Also included: enclosed circuit breakers for independent mounting.

B. Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General- and Supplementary-Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 6.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. Institute of Electrical and Electronics Engineers
 - a. IEEE 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
4. NEC National Electrical Code (NFPA 70)
5. NECA National Electrical Contractors Association "Standard of Installation"
6. National Electrical Manufacturers Association
 - a. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. NEMA AB 1 Molded-Case Circuit Breakers
 - c. NEMA FU 1 Low Voltage Cartridge Fuses
 - d. NEMA KS 1 Enclosed Switches
7. NFPA National Fire Protection Association
8. UL Underwriters Laboratories, Inc.
 - a. UL 98 Enclosed and Dead-Front Switches
 - b. UL 198C High-Interrupting-Capacity Fuses, Current-Limiting Type

- Fuses
- c. UL 198E Class R Fuses
- d. UL 198F Plug Fuses
- e. UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
- f. UL 486B Wire Connectors for Use with Aluminum Conductors
- g. UL 489 Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- h. UL 943 Ground-Fault Circuit Interrupters
- i. UL 977 Fused Power-Circuit Devices

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Shop Drawings: Submit shop drawings and or brochures to include but not limited to minimum melting and total clearing time charts for all fuses.
- C. Product Data: Submit for each type of product specified. Include manufacturer's bulletins, and minimum melting and total clearing time charts for each type of fuse.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
 - 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260501.
- E. Samples: Provide samples upon specific request.
- F. Certificates:
 - 1. Labels of UL listing, fixed to each item of material.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."

- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

1.7 COORDINATION

- A. For equipment furnished by the Owner, or under other Divisions: Size fuses in accordance with the National Electrical Code.

1.8 EXTRA MATERIALS

- A. Furnish 3 of each type and size of fuse installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Circuit Breakers:
 - 1. General Electric Co.
 - 2. Square D Co.
 - 3. Cutler-Hammer

- B. Fuses:
 - 1. Bussmann only.

2.2 MATERIALS AND FABRICATION

- A. Circuit Breakers:
 - 1. Circuit Breakers: Molded case, quick-make, quick-break, thermal-magnetic, trip-free with individual inverse time tripping mechanism on each pole.

Terminal lugs rated for copper and aluminum conductors. Minimum 10,000 amperes interrupting capacity, RMS symmetrical short circuit rating shall be required. All breakers shall meet or exceed the maximum available fault current as indicated on single line diagram.

- a. Use magnetic-only circuit breakers for motor applications.
- b. Provide Class A (5ma sensitivity) breakers where GFI type breakers are required.
- c. Provide "HACR" type circuit breakers for HVAC loads. Ratings shall be as indicated on the drawings.
- d. No tie handle on multi-pole circuit breaker is accepted.
- e. Provide ambient compensated type breaker where the breaker is installed in the ambient in excess of 40 degrees C (104 degrees F).

B. Fuses:

1. Class RK1:
 - a. 250V; LPN-RK, Lowpeak
 - b. 600V; LPS-RK
2. Class L: KRP-C, Hi-Cap
3. Or as otherwise shown on the drawings.

PART 3 - EXECUTION

3.1 APPLICATION

A. Types: Mains, Feeders and Branch Circuits.

1. 600 Amps and Below: Dual-element construction (current limiting, time-delay and high interrupting capacity) providing thermal protection for both fuse and fuseholder. Interrupting rating shall be 300,000 amperes RMS symmetrical and peak let-thru current and energy let-thru values shall not exceed the values established by Underwriters' Laboratories Standard for Class RK-1 fuses. Fuses shall be Bussmann "Low Peak Yellow™" in color and shall be Bussmann Low-Peak Dual Element Fuses, types LPN-RK (250 volts) or LPS-RK (600 volts). The fuses shall have separate overload and short-circuit elements. The fuses shall incorporate a spring activated thermal overload element having a 284 degree Fahrenheit melting point alloy and shall be independent of the short-circuit clearing chamber. Fuses shall be "Low Peak Yellow™". CAUTION labels to alert the end user of the engineered level of protection of the electrical equipment, shall be field installed by the electrical contractor. They shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure. These labels are available with the spare fuse cabinet (SFC) and are also available upon request from Bussmann.
2. Above 600 Amps: Time delay type; shall hold 500% of rated current for a minimum of 4 seconds and clear 20 times rated current in .01 seconds or less. Interrupting ratings shall be 200,000 amperes RMS symmetrical and

peak let-thru current and energy let-thru values shall not exceed the values established by Underwriters' Laboratories for Class L fuses. Fuses shall be Bussmann "Low Peak Yellow™" in color and shall be Bussmann LOW PEAK type KRP-C. The fuses shall employ "O" rings as positive seals between the end bells and the glass melamine fuse barrel. The fuse links shall be pure silver links (99.9% pure), to limit the short circuit current let-through values to low levels and comply with NEC Sections requiring component protection. The terminals shall be panned. CAUTION labels to alert the end user of the engineered level of protection of the electrical equipment, shall be field installed by the electrical contractor. They shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure. These labels are available with the spare fuse cabinet (SFC) and are also available upon request from Bussmann.

- B. Motor Circuits - All individual motor circuits with full load amperes rating (FLA) of 480 amperes or less shall be protected by BUSSMANN LOW-PEAK Dual-Element, time delay to provide type 2 coordination for the controller, Fuses LPN-RK (250 volts) or LPS-RK (600 volts). The fuses for motors with a marked service factor not less than 1.15 or with a marked temperature rise not over 40 degrees Centigrade, shall be installed in ratings of approximately 125% of motor full load current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly such as large fans. Under such conditions the fuse should be 150% to 175% of the motor full load current. Larger H.P. motors shall be protected by BUSSMANN Type KRP-C Low-Peak Time-Delay Fuses of the ratings shown on the drawings. All other motors, (such as 1.0 service factor motors) shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) installed in ratings of approximately 115% of the motor full load current except as noted above. The fuses shall be U.L. Class RK1 Dual Element Time Delay or Class L. CAUTION labels to alert the end user of the engineered level of protection of the electrical equipment, shall be field installed by the electrical contractor. They shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure. These labels are available with the spare fuse cabinet (SFC) and are also available upon request from Bussmann.
- C. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) or BUSSMANN Low-Peak KRP-C Time Delay Fuses as shown on the drawings. The fuses shall be U.L. Class RK1 or Class L. Protection shall be based on the circuit breakers interrupting capacity, as outlined in the Bussmann Bulletin PMCB. CAUTION labels to alert the end user of the engineered level of protection of the electrical equipment, shall be field installed by the electrical contractor. they shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure. These labels are available with the spare fuse cabinet (SFC) and are also available upon request from Bussmann.
- D. Provide Class RK1 fuses for motors, feeder circuits, and other circuits not specified below 0-600 amps.
- E. Provide Class RK1 fuses for lighting loads, 0-600 amps:

1. For fluorescent ballasts - Type GLR.
 2. For other ballasts and control circuits - Type KTK.
- F. Provide Class L fuses for all applications, 601 amps and larger.
- G. Special Applications:
1. Fluorescent fixtures shall be protected by Bussmann fuses GLR or GMF with holder HLR. They shall have individual protection on the line side of the ballast. A fuse and holder shall be mounted within or as part of the fixture. Size and type of fuse to be recommended by the ballast manufacturer.
 2. All other ballast-controlled lighting fixtures shall be protected by Bussmann fuses type KTK or FNQ with holders HEB, HPF, or HPS. They shall have individual protection on the line side of the ballast. Fuse and holder shall be mounted in a location convenient for changing fuses. Holder shall be mounted in protected location or be an in-line waterproof holder. Size and type of fuse to be recommended by the ballast manufacturer or as indicated on plans.

3.2 INSTALLATION

- A. Set adjustable circuit breakers with trips as indicated.
- B. Provide separate neutral conductors for circuits protected by GFI breakers.
- C. Provide Class RK5 fuses for motors, feeder circuits, and other circuits not specified below 0-600 amps.
- D. Provide Class RK1 fuses for lighting loads, 0-600 amps:
1. For fluorescent ballasts - Type GLR.
 2. For other ballasts and control circuits - Type KTK.
- E. Provide Class L fuses for all applications, 601 amps and larger.
- F. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

3.3 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates with 1/4-inch minimum height letters indicating:
1. Circuit designation at branch overcurrent devices in distribution panelboards, switchboards and motor control centers.
 2. Circuit designation of panel or device controlled on circuit breakers, individually enclosed.

- B. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

3.4 SPARES

- A. In addition to fuses consumed during testing, furnish 10%, but not less than three each of each size and type fuses used for the project and store where directed by Owner. Mount spare fuses in a NEMA 1 lockable cabinet with full plywood backboard.

END OF SECTION 262801

**SECTION 265110
INTERIOR LIGHTING**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes:

1. Lighting fixtures (for interior applications).
2. Emergency lighting units.
3. Illuminated exit signs.
4. Lighting fixture components and accessories.

B. Lighting Fixtures - Required Types and Characteristics: Applicable information on the type and characteristics of lighting fixtures required are indicated herein, shown on the plans (including the use of lighting fixture schedules), and tabulated in other Sections of these Specifications.

C. Related Sections:

1. General electrical requirements: Section 260501.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. American National Standards Institute
 - a. ANSI C78.379 Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification and Beam Patterns
 - b. ANSI C82.1 Ballasts for Fluorescent Lamps - Specifications
 - c. ANSI C82.4 Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type)
2. ASTM American Society for Testing and Materials
3. Certified Ballasts Manufacturers Association
 - a. Lamp and ballast combinations safety and performance standards
4. IEEE Institute of Electrical and Electronics Engineers
5. NEC National Electrical Code (NFPA 70)

6. NECA National Electrical Contractors Association "Standard of Installation"
7. National Electrical Manufacturers Association
 - a. NEMA WD 6 Wiring Devices - Dimensional Requirements
8. NFPA National Fire Protection Association
9. National Life Safety Code (NFPA 101)
10. Underwriters Laboratories, Inc.
 - a. UL 57 Fixtures, Electric Lighting.
 - b. UL 924 Emergency Lighting and Power Equipment
 - c. UL 1570 Fixtures, Fluorescent Lighting.
 - d. UL 1752 Fixtures, High Intensity Discharge Lighting.
 - e. UL 1571 Fixtures, Incandescent Lighting.
 - f. UL 935 Ballast, Fluorescent Lamps.
 - g. UL 1029 Ballast, High Intensity Discharge Lighting.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Shop Drawings: Details of assembly, component dimensions, wiring and interconnection, materials lists, finishes, and installation requirements.
- C. Product Data: Submit for each type of product specified. Include manufacturer's product data giving materials, finishes, dimensions, coefficients of utilization, and lamp types for each fixture which is the product of one of the listed acceptable manufacturers.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260501.
- E. Samples: Provide samples upon specific request.
- F. Certificates:
 1. Labels of UL listing, fixed to each item of material.
 2. Labels of Certified Ballasts Manufacturers and Electrical Testing Laboratories affixed to each item of material.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.

- B. Laboratory Testing: Photometric testing shall be by Independent Testing Laboratories, Inc., based on Illuminating Engineering Society published procedures, and shall include candlepower distribution tabulation and zonal cavity coefficient of utilization tabulation.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- D. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- E. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- F. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260501, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. As indicated herein, and as shown on the Lighting Fixture Schedule.

2.2 ELECTRICAL LIGHTING FIXTURES

- A. Work covered includes manufacturing, equipping, wiring, and assembling of all lighting fixtures. Provide lighting fixtures complete for each and every light outlet in the type, quality, and size of fixture indicated in lighting fixture schedule.
- B. The lighting fixtures shown on fixture schedule are marked with the corresponding type of letter, indicating thereby the particular type of fixture to be installed on the respective outlets.

- C. Include a lighting fixture on every light outlet shown, unless otherwise indicated to be omitted. If the type of lighting fixture is not specifically noted, provide without extra cost to the Owner, a lighting fixture of the same type called for under a similar condition elsewhere on the Contract Drawings.
- D. Catalog No. on the lighting fixture schedule are for the purpose of indicating the general type, quality, and size of fixtures that will be required. The use of Catalog Nos. for a lighting fixture does not necessarily include all accessories that may be required for a complete and operational installation.
- E. All luminaries and other lighting equipment delivered to the job complete, wired and including all supporting means, such as plaster frames, supports, hangers, canopies, sockets, holds, all current or voltage modifiers, such as ballasts, starters, all light control materials; specifically diffusers, louvers, lenses, reflectors and refractors.
- F. All lighting fixtures constructed and installed in accordance with local building codes and directives by the NFPA and shall bear the label of approval of the U.L. All materials new and of best grade of approved manufacturing standards. Workmanship of highest order to assure trouble-free operation and durability of equipment. Lighting fixtures constructed by labor agreeable with that employed on the project.
- G. Lighting fixtures to be designed for highest relative efficiency and service. Maintenance to be simple and re-lamping possible without use of special tools.
- H. Provide all light-sources, lamps and other light-producing media called for and suitable for specified equipment and functions.

2.3 FLUORESCENT LIGHTING FIXTURES

- A. Fluorescent luminaries to use not less than No. 16 gauge SF-2 wire. No splice or tap located within a fixture arm, stem or chain. Wire continuous from lamp socket, or from internally mounted ballast, to splice with building wire whether splice box is mounted on fixture or attached to building.
- B. Fluorescent lampholders, white plaster, designed for spring loaded contacts or Bi-Pin contacts, as required, for specified lamp requirements.
- C. Fluorescent lighting fixture body parts, comprising the lighting fixture housing, reflectors, wire channels, end plates, ballast housing, and similar body parts, to be made of extruded aluminum, galvanized stampings, or bonderized steel, as indicated in the lighting fixture schedule. Wire-ways to have adequate wiring space, accessible after fixture installation. Housing adequately ventilated where required. All screws and nuts have rust-proof finish.
- D. All fluorescent lighting fixtures supplied with ballasts wired for the branch circuit wiring.
- E. Where recessed fluorescent lighting fixtures are installed in ceiling finished with acoustical tile or grid system, the lighting fixture shall conform to the patterns

indicated on the Architectural Reflected Ceiling Plan.

- F. The final installation must present a symmetrical appearance, with all lighting fixtures free of any damage and thoroughly clean.
- G. Provide all additional means necessary to support lighting fixtures that would put excessive stress on the ceiling system.
- H. Lighting fixtures mounted end-to-end and used as a raceway to be mechanically bonded together to insure continuity of ground. Lighting fixtures used as "feed through" to have wireways of adequate size.
- I. All plastic lens or shielding for fluorescent lighting fixtures to be made from 100% virgin acrylic unless otherwise specified.
- J. Temperature around ballast and in fixture housing shall not exceed 90 degrees C. with ambient room temperature at 27 degrees C.
- K. Fluorescent lighting fixtures exposed to outside temperatures supplied with 0 degree F. ballasts.

2.4 LIGHTING FIXTURE NOTES

- A. Recessed lighting fixtures in plaster or drywall ceilings to be furnished with plaster frames.
- B. Lighting fixtures recessed in furred ceiling installed so that they can be removed from below the ceiling without damage to the ceiling.
- C. Recessed lighting fixtures to be installed with metal bar hangers for attaching to ceiling supports. Lighting fixtures not supported directly from ceiling, provide galvanized steel wire as required for supporting lighting fixture from structure. No wood or other combustible material to be used for supporting fixtures.
- D. Provide stems with swivel joints and canopies for all suspended lighting fixtures. Finish of all exposed parts to match that of the associated fixture, unless otherwise noted. Design to conform to Drawings. Wiring to pendant fixtures contained within stems. Wire entry by means of heavy malleable iron hickies.
- E. A canopy to be furnished for each stem and all canopies to match for each fixture type, as shown.
- F. Ascertain type of ceiling construction for each fixture and provide suitable frames and fixture accessories to suit. Furnish substantial mounting frames or plaster rings for all recessed and semi-recessed lighting fixtures indicated or required. All frames made of galvanized steel with extra cross members where required to insure maintenance or proper opening dimensions during installation.

2.5 LAMPS

- A. Provide energy saving lamps for all fixtures as manufactured by Sylvania, Cutler-Hammer, or General Electric as specified in Fixture Schedule.

2.6 BALLASTS

- A. Electronic ballasts shall be Magnetek "Triad" series or equal by Advance, E.B.T. or Motorola. Electronic ballasts shall be high-frequency, full-output, U.L. listed and ETL certified, class "P" high power factor, with an "A" sound rating or better. All electronic ballasts shall have less than 10% total harmonic distortion, shall have a maximum lamp current crest factor of 1.7, and shall be warranted for parts and replacement labor for one full year from the date of installation. Ballasts for 1-, 2-, 3-, or 4- lamp combinations shall be used as specified in the lighting fixture schedule.
 - 1. Electronic dimming ballasts shall have dimming range from 100% to 1% for T-12 and T-8 lamps, 100% to 5% for T-5 and T-4 lamps, and shall be approved for application by the dimming system manufacturer. Electronic dimming ballasts shall internally limit inrush current and preheat lamp cathodes before applying arc voltage to ensure rated lamp life is not diminished. Electronic dimming ballasts shall be available in 1-, 2-, or 3-lamp combinations as specified in lighting fixture schedule. Lead length from electronic dimming ballast to lamp socket shall not exceed seven feet for T-8 or three feet for T-5 lamps. Lamps operated by electronic dimming ballast shall be burned in at 100% light for 100 hours before being dimmed. Electronic dimming ballasts shall be Lutron Hi-Lume FDB Series, or equal.
- B. Magnetic fluorescent ballast shall be energy saving type General Electric Maxi-Miser II or equal Universal, Advance.
- C. Ballast for fixtures installed outdoors, shall be exterior type for 0 degrees F starting.
- D. Ballast for H.I.D. fixtures shall be high power factor type (minimum 0.9). Starting amount shall not exceed operating current.
- E. Rapid-start fluorescent fixtures shall be furnished with ETL and U.L. approved high power factor "P" rated ballasts complete with automatic reset thermal protection. All ballasts shall be acoustically rated "A".
- F. Temperature rise of the ballasts in fixtures not to exceed 45 degrees C on test and mounted in the fixture housing and secured in place by means of bolts, screws, lock washers and nuts.
- G. Ballasts for magnetic fluorescent lamps shall be one or two lamp type only. Where one lamp fixtures are used in continuous rows, two lamp ballasts utilized except where odd lamps occur at end of rows. Ballasts have a power factor of 90% or higher and operate at not higher than 120% of rated current nor rated line voltage. All ballasts carry a 2-year guarantee for material and labor on replacement. Guarantee period starts after Architect's acceptance in writing of lighting installations.
- H. All ballasts shall have power factor not less than 0.9.

2.7 MATERIALS

- A. Outlet Boxes: Refer to Section 260526.
- B. Conduits: Refer to Section 260533.
- C. Wires and Cables: Refer to Section 260519.
- D. Fixtures: Of types scheduled, type letter referring to designation on the Drawings.
- E. Lamps:
 - 1. Manufacturers: General Electric, Phillips, Osram, Sylvania.
 - 2. Incandescent: Inside frosted, 130 volts, of sizes scheduled.
 - 3. Fluorescent:
 - a. 32 watt lamps
 - 1) Equal to General Electric 32-T8-SP35 U.O.N.
 - 2) Rated not less than 2850 lumens output after 100 hours.
 - b. 40 watt lamps
 - 1) Equal to General Electric F40-T12-CW-RS.
 - 2) Rated not less than 3150 lumens output after 100 hours.
 - 4. High Intensity Discharge:
 - a. Phosphor coated. Clear lamps not allowed.
 - b. Select proper operating position and voltage.
- F. Accessories:
 - 1. Manufacturer's standard mounting rings, trim flanges, hanger bars, spacers, supports, plaster frames of nonferrous material or cadmium plated steel. Do not use painted steel plaster frames.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect Architectural drawings and specifications, including ceiling alternates, to determine ceiling material to be installed.
- B. Inspect Architectural reflected ceiling plans.
- C. Inspect installed ceiling components for defects affecting the quality and execution of work.

3.2 PREPARATION

- A. Verify ceiling material and alignment.
- B. Lay out exact locations of fixtures in accordance with reflected ceiling plans, fixtures' and switches' outlet boxes and supports.
- C. Provide outlet boxes and conduit.
- D. Provide appropriate hardware and fixture accessories to support from ceiling system.

3.3 INSTALLATION

- A. Installation of all lighting fixtures done by experienced electrician. Lighting fixtures not installed where finished coat of paint has been applied to ceiling and walls until paint is thoroughly dry. Verify ceiling type with architectural plan and provide all necessary framing and mounting hardware.
- B. Contractor to be responsible for proper coordination of all lighting fixture locations. Provide support for all lighting fixtures mounted on or recessed in hung ceiling. Confer with Ceiling Contractor and other trades to coordinate lighting systems.
- C. Lighting fixtures to be rigidly mounted to fixture stud in outlet boxes. Malleable iron hickies or extension pieces provided where required.
- D. Provide suitable coverplate or canopy for each lighting fixture outlet box where the lighting fixture does not provide a suitable cover.
- E. Lighting fixtures located on exterior of building installed with cadmium plated brass screws and gasketed.
- F. Lighting fixture to be installed in suspended T-Bar ceiling shall be attached to the ceiling grid with an attachment device with a capacity capable to resist a force equal to the weight of the light fixture acting in any direction. Lighting fixtures shall be supported directly from the structure above by hangers capable of supporting the weight of the fixture with #12 galvanized steel wire from all 4 corners.
- G. Verify all ceiling heights and clearances if mounting height is not indicated on plans or in lighting fixture schedule, or if lighting fixture is relocated because of a conflict with another trade. A mounting height for the lighting fixture is to be submitted for review.
- H. Each lighting fixture completely wired in an approved manner with No. 14 AWG copper stranded wire, 600 volt, with type SF-2 insulation; recessed lay-in lighting fixtures furnished with 7 feet No. 14 SF wire and 6 feet Greenfield, 4 feet when installed in an air plenum.
- I. Circuit wiring running through the lighting fixtures to be No. 12 AWG with type SF insulation. No joints in the wires other than those absolutely required. Provide wires of sufficient length for making approved connections at the light outlets and at

the lampholders or ballasts.

- J. Joints and splices within lighting fixtures to be either soldered and taped with plastic electrician's tape or secured by wire nuts or indent type lug fasteners.
- K. Protect the lighting fixtures from damage during their unloading or removal, storage or installation, any broken fixtures, lenses, etc. must be replaced with new parts, without any additional expense to the Owner, undue delay or inconvenience.
- L. Upon completion of the installation of the lighting fixtures and lighting equipment, they must be in first-class operating order and in perfect condition as to finish, etc. Check for proper operation and appearance, alignment of fixtures and proper placement of lenses, louvers, lamps and other light-controlling or modifying appurtenances.
- M. Where special lighting effects, flood or spotlighting is involved, perform final adjustment under the direct supervision of Architect.
- N. Cleaning: Immediately prior to occupancy, damp clean all lenses, lighting fixture trims, reflectors, clean lamps or install new lamps as directed, with lenses and fixtures free of labels.
- O. Use of Lighting Fixtures: As soon as any portion of lighting fixture work is ready for operation, the Owner shall have the right to operate the same under the supervision of the Contractor. This shall in no way be interpreted to mean the acceptance of such part of the installation or relieve the Contractor of his responsibility for the complete work or any part thereof.
- P. Color and type of finish of all lighting fixtures as approved by the Architect.
- Q. Install fixtures and accessories in accordance with manufacturer's recommendations and industry standard practice.
- R. Coordinate work of this section with that of other trades.
- S. Provide lighting fixtures, lamps, switches, and control systems, and wiring.
- T. If designation omitted on drawings, provide same type fixture employed in rooms of similar usage (contact this engineer for final direction).
- U. Provide spacers for fixtures mounted on low density ceiling material.
- V. Provide plaster frames for recessed fixtures in plaster ceilings.
- W. Install fixtures in fiber decking and formboard so outlet boxes and openings will not be sight exposed.
- X. Prepare fixtures and trim required to be painted.
- Y. Outlet boxes locations on drawings are diagrammatic only. Position outlet boxes to coincide with suspension hangers and knock-outs.

- Z. Install in accordance with manufacturer's instructions, submittal data, and details on drawings.

3.4 ADJUSTMENT AND CLEANING

- A. Adjust lamp positions for desired effects.
 - 1. Adjust lamp positions for desired effects.
 - 2. Align fixtures with building walls and tile joints.
- B. Cleaning
 - 1. Remove dirt, grease, and foreign materials from fixtures.
 - 2. Remove fingerprints, smudges, and dirt from fixtures' lenses and lamps.

END OF SECTION 265110

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Driveways.
 - 2. Roadways.
 - 3. Parking lots.
 - 4. Curbs and gutters.
 - 5. Walks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Other Action Submittals:
 - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- F. Deformed-Steel Wire: ASTM A 496/A 496M.
- G. Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150, white portland cement Type V. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - 2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.
- B. Normal-Weight Aggregates: ASTM C 33, Class to be determined by engineer, uniformly graded. Provide aggregates from a single source.
 - 1. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.
- C. Water: Potable and complying with ASTM C 94/C 94M.

- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.05 percent water-soluble chloride ions by mass of cementitious material.

2.3 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Form Release Agent: Low VOC concrete form release agent for use on metal, plastic, wood, and composite forms.

2.6 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Refer to Section 321723 "Pavement Markings"

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
 - 1. Compressive Strength (28 Days): psi to be determined by engineer.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: to be determined/confirmed with Engineer.
 - 3. Slump Limit: to be determined by engineer.
 - 4. Air Content: percent plus or minus 1.5 percent to be determined by engineer.
- B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- C. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.(to be confirmed by engineer)

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving where occurs.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, curing compound or a combination of these.

3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/2 inch.
 - 4. Joint Spacing: 3 inches.

5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.9 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wheel stops.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
 - 1. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 10-inch minimum length.
 - 2. Color:

Paint shall comply with Section 099113 Exterior Painting.

 - a. Bumpers in accessible parking stalls shall be painted blue to match the accessible signage symbol.
 - b. Bumpers in truck parking stalls shall be painted caution yellow.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
- B. Install wheel stops in bed of adhesive before anchoring.
- C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer.

END OF SECTION 321713

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes painted markings applied to asphalt and concrete pavement.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For interior, field-applied, pavement-marking paints, documentation including printed statement of VOC content.
- C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Aexcel Inc.
 - 2. Benjamin Moore & Co.
 - 3. Color Wheel Paints & Coatings.
 - 4. Columbia Paint & Coatings.
 - 5. Conco Paints.
 - 6. Coronado Paint; Division of INSL-X Products Corporation.
 - 7. Diamond Vogel Paints.
 - 8. Dunn-Edwards Corporation.
 - 9. Ennis Traffic Safety Solutions, Inc.
 - 10. Frazee Paint.
 - 11. General Paint.
 - 12. Kwal Paint.
 - 13. M.A.B. Paints.
 - 14. McCormick Paints.
 - 15. Miller Paint.

16. Parker Paint Mfg. Co. Inc.
17. PPG Industries.
18. Pratt & Lambert.
19. Rodda Paint Co.
20. Rohm and Haas Company; a subsidiary of The Dow Chemical Company.
21. Scott Paint Company.
22. Sherwin-Williams Company (The).

2.2 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: MPI #32, alkyd traffic-marking paint.
 1. Color: White and/or Blue at accessible spaces.
- B. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.
 1. Color: White and/or Blue at accessible spaces>.
- C. Glass Beads: AASHTO M 247, Type 1.
- D. VOC Content: Pavement markings used on building interior shall have a VOC content of 150 g/L or less.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils. Apply paint so that it cannot run beneath the stencil.
 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal..

END OF SECTION 321723

SECTION 321726 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place detectable warning tiles.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
- C. Samples for each type of exposed finish requiring color selection.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.
 - 1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Recycled Content of Detectable Warning Tiles: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- C. Regional Materials: Detectable warning tiles shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles with replaceable surface configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
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. Access Products, Inc.
 - b. ADA Solutions, Inc.
 - c. Advanced Surface Systems, LLC.
 - d. AlertTile; a division of Cape Fear Systems, II, LLC.
 - e. Armorcast Products Co.
 - f. Detectable Warning Systems, Inc.
 - g. Detectile, Inc.
 - h. Engineered Plastics, Inc.; Armor-Tile.
 - i. StrongGo Industries, LLC.
 - j. Transpo Industries, Inc.
 2. Material: Cast-fiber-reinforced polymer concrete tile
 3. Color: Safety yellow
 4. Shapes and Sizes:
 - a. Rectangular panel, 12 by 12 inches
 5. Dome Spacing and Configuration: As indicated on drawings.
 6. Mounting:
 - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
 - b. Detectable warning tile set into formed recess in concrete and adhered with mortar.
 - c. Replaceable detectable warning tile wet-set into freshly poured concrete and surface-fastened to permanently embedded anchors.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
1. Furnish Type 304 stainless-steel fasteners for exterior use.
 2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

- C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.
- C. Cast-in-Place Detectable Warning Tiles: Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. Set surface of tile flush with surrounding concrete and adjacent tiles. Remove concrete from tile surfaces and clean using methods recommended in writing by manufacturer.
- D. Removable Cast-in-Place Detectable Warning Tiles: Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. Set surface of tile flush with surrounding concrete and adjacent tiles. Remove concrete from tile surfaces and clean tiles using methods recommended in writing by manufacturer.
- E. Surface-Applied Detectable Warning Tiles: Prepare existing paving surface by grinding and cleaning as recommended by manufacturer. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Apply sealant in continuous bead around perimeter of installation.
- F. Surface-Applied Detectable Warning Mats: Prepare existing paving surface by grinding and cleaning as recommended by manufacturer. Apply adhesive to back of mat and set mat in place. Firmly seat mat in adhesive bed. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface. Apply sealant in continuous bead around perimeter of mat.
- G. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- H. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 323113.53 - HIGH-SECURITY CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes high-security chain-link fences and motor-operated, horizontal slide gates.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Chain-link fences and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:
 - 1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet (3.66 m) high, and post spacing not to exceed 10 feet (3 m) for Material Group IA, ASTM F 1043, Schedule 40 steel pipe.
 - 2. Minimum Post Size and Maximum Spacing: Provide line posts of size and in spacing indicated, but not less than sizes and spacings determined according to ASTM F 1916, including Appendix based on mesh size and pattern specified and the following:
 - a. Exposure Category: C.
 - b. Fence Height: 10 feet (3 m).
 - c. Material Group: IA, ASTM F 1043, Schedule 40 steel pipe.
 - 3. Fabric Tension: Provide fences in which fabric deflections do not exceed those indicated in Table X1.1 of ASTM F 1916 when tested by applying a 30-lbf (133-N) force at midpoint between rails and horizontally between posts for every eighth lower panel along the fence line.
 - 4. Fence Post Rigidity: Provide fences in which post deflections do not exceed 3/4 inch (19 mm) when tested according to ASTM F 1916 by applying a 50-lbf (222-N) force at midheight of every eighth post along the fence line.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.
- C. Samples: For each polymer-coated component and accessory.

- D. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of chain-link fence, operator, and gate, from manufacturer.
- B. Product Test Reports: For framing strength according to ASTM F 1043.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding. Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. 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.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of high-security chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deflection of fence fabric beyond design limits.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate operators and controls.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. Chain-Link Fence Fabric: Provide fabric in two-piece heights measured between top and bottom of outer edge of selvage. Comply with CLFMI Product Manual and with requirements indicated below:
1. Fabric Height:
 - a. Steel Wire Fabric: Wire with a diameter of 0.148 inch
 - 1) Mesh Size: 2 inches
 2. Zinc-Coated Fabric: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. with zinc coating applied before weaving.
 - a. Color: Black, complying with ASTM F 934.
 3. Selvage: Twisted and barbed top and bottom.

2.2 SECURITY FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts.
1. Fence Height: As indicated on Drawings
 2. Heavy Industrial Strength: Material Group IA, round steel pipe, Schedule 40.
 - a. Line Post: 2.25 by 1.70 inches
 - b. End, Corner, and Pull Post: 4.0 inches in diameter]
 3. Rail Members: Intermediate top and brace rails complying with ASTM F 1043 for Heavy Industrial.
 4. Metallic Coating for Steel Framing:
 - a. External, Type B, zinc with organic overcoat; internal, Type D, zinc-pigmented coating.
 5. Polymer coating over metallic coating.
 - a. Color: Black, complying with ASTM F 934.

2.3 TENSION WIRE

- A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire complying with ASTM A 817 and ASTM A 824, with the following metallic coating:
1. Type II, zinc coated with minimum coating weight matching chain-link fabric coating weight.

- B. Polymer-Coated Steel Wire: 0.177-inch-diameter, tension wire complying with ASTM F 1664, Class 2a over zinc coated steel wire.
 - 1. Color: Black complying with ASTM F 934.

2.4 HORIZONTAL-SLIDE GATES

- A. General: Comply with ASTM F 1184 for gate posts and single or double sliding gate types. Provide automated vehicular gates that comply with ASTM F 2200.
 - 1. Classification: Type I Overhead Slide.
 - 2. Classification: Type II Cantilever Slide, Class 1 with external roller assemblies.
- B. Pipe and Tubing:
 - 1. Zinc-Coated Steel: Manufacturer's standard protective coating and finish >.
 - 2. Aluminum: Comply with ASTM B 429/B 429M; mill finish.
 - 3. Gate Post Size and Weight: Not less than required by ASTM F 1184 and/or ASTM F 1916.
 - 4. Gate Frames and Bracing: Round tubular steel
- C. Frame Corner Construction: Assembled with corner fittings and 3/8-inch-diameter, adjustable truss rods for panels 5 feet or wider.
- D. Extended Gate Posts and Frame Members: Extend above top of chain-link fabric at both ends of gate frame 12 inches .

2.5 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Tie Wires, Clips, and Fasteners: Comply with ASTM F 626 and ASTM F 1916.
- C. Power-Driven Fabric Fasteners: Comply with ASTM F 1916.
- D. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. of zinc.
 - a. Polymer coating over metallic coating.

2.6 GATE OPERATORS

- A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
 2. Provide operator with UL-approved components.
 3. Provide electronic components with built-in troubleshooting diagnostic feature.
 4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.
- B. Comply with NFPA 70.
- C. UL Standard: Manufacturer and label gate operators to comply with UL 325.
- D. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
1. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected..
 2. Horsepower: 1/4, unless directed otherwise. Coordinate with Owner.
 3. Enclosure: Manufacturer's standard.
 4. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
 5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
 6. Phase: Coordinate with Owner provided motor.
- E. Remote Controls: Vehicle loop detector.

2.7 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
- D. Install chain-link fencing to comply with ASTM F 567, ASTM F 1916, and more stringent requirements specified.
- E. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- F. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting.
 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Top below grade as indicated on Drawings to allow covering with surface material.
 - b. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
 - c. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- G. Terminal Posts: Locate and install terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more, at any abrupt change in grade, and at intervals not greater than 500 feet. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- H. Line Posts: Space line posts uniformly at 10 feet o.c.
- I. Tension Wire: Install according to ASTM F 567 and ASTM F 1916, maintaining plumb position and alignment of fencing. Provide horizontal tension wire at the following locations:
1. Extended along top and bottom of fence fabric.

- J. Bottom Rails: Install and secure to posts with fittings; anchor rail at midspan to concrete footing.
- K. Chain-Link Fabric: Apply fabric on the approach side of fence, inside of enclosing framework.
 - 1. Where indicated, bury an 18-inch-wide, polymer-coated fabric 12 inches into trench; overlap above-grade fabric 6 inches and secure to bottom rail with tie wires. Backfill and compact trench.
- L. Power-Driven Fasteners: Fasten 0.192- or 0.148-inch wire fabric with 2- or 1-inch mesh size.
 - 1. Fasten fabric to line posts 12 inches o.c. and to braces 24 inches o.c.
- M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- N. Ground Barrier Stakes: Stake coils at 10 feet o.c., driven to full depth.
- O. Gates: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.
- P. Adjustment: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.

3.2 FIELD QUALITY CONTROL

- A. Fabric Testing: Test fabric tension according to ASTM F 1916.
- B. Fence Post Rigidity Testing: Test line posts for rigidity according to ASTM F 1916.

END OF SECTION 323113.53